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(54) **SURGICAL ARTICLES AND METHODS**

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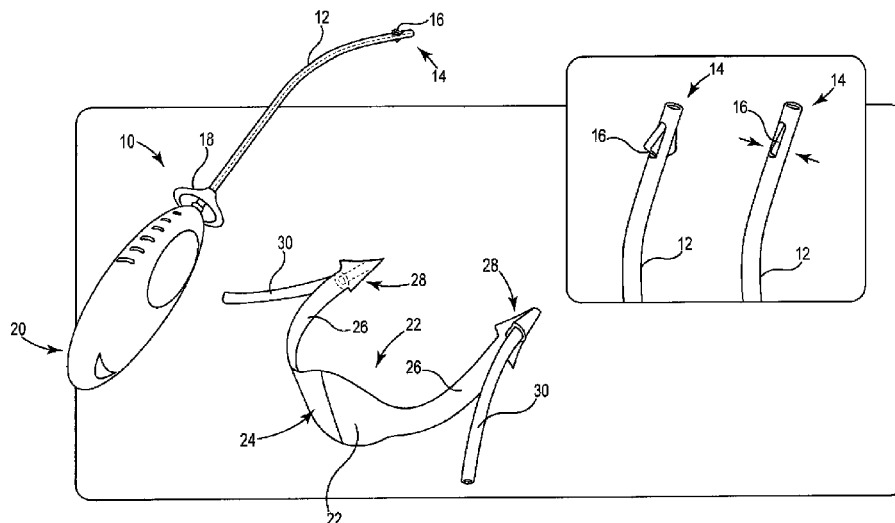
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(57) **ABSTRACT**

Described are devices, implants, kits, and related methods for treating pelvic conditions such as urinary incontinence, in a male or a female patient.

13 Claims, 33 Drawing Sheets



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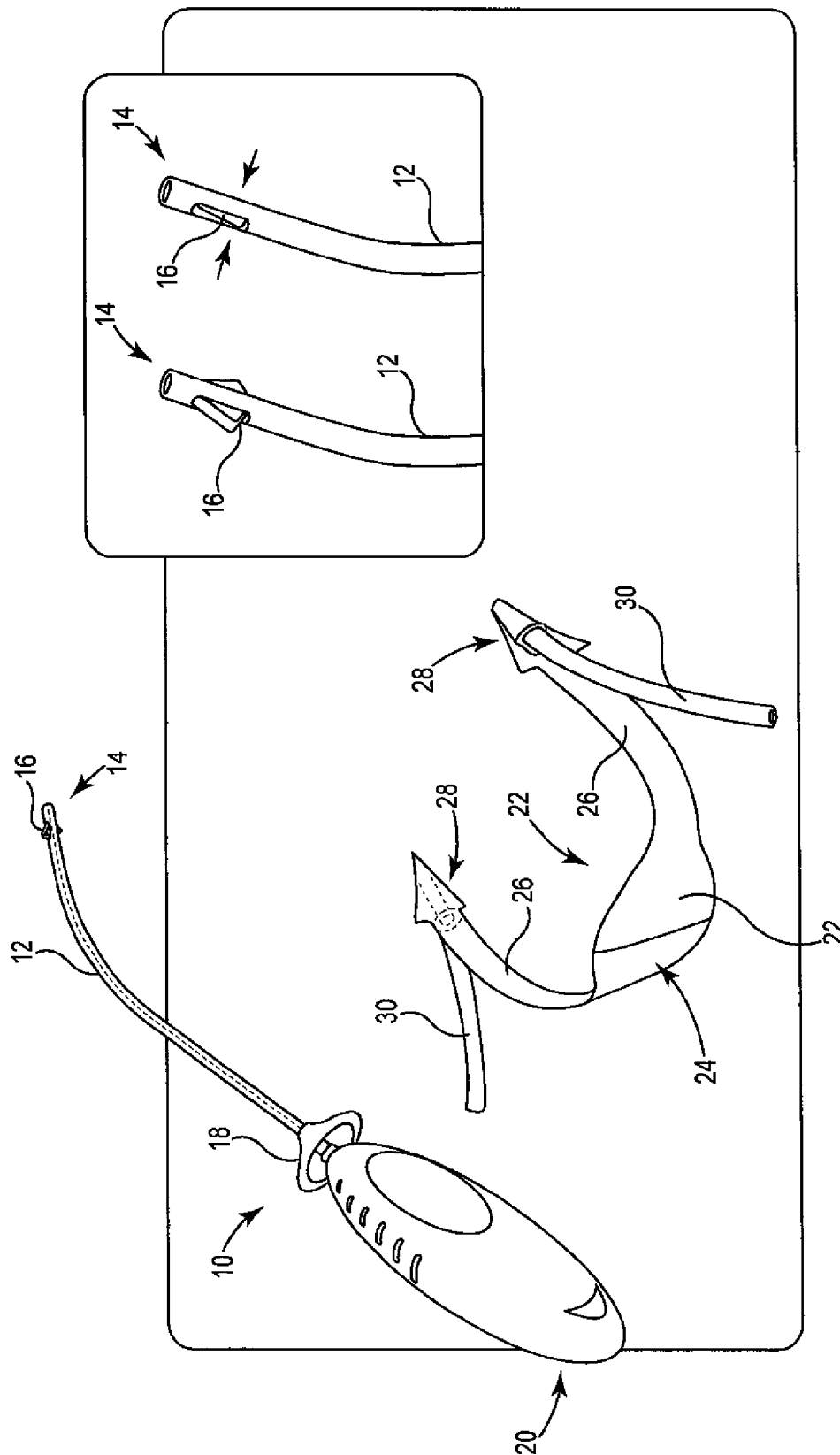
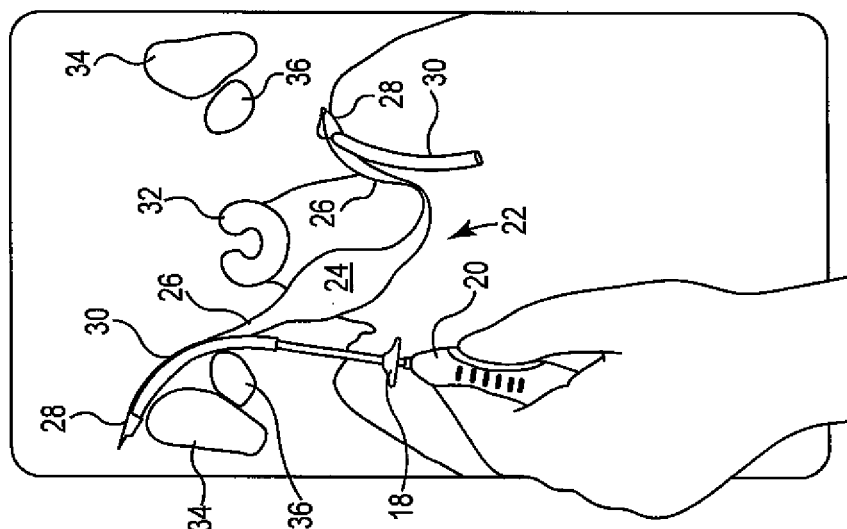
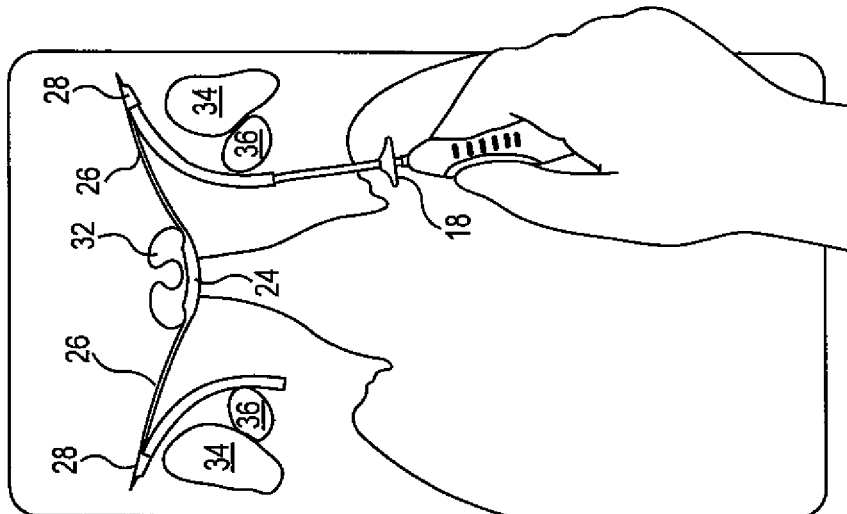


Fig. 1



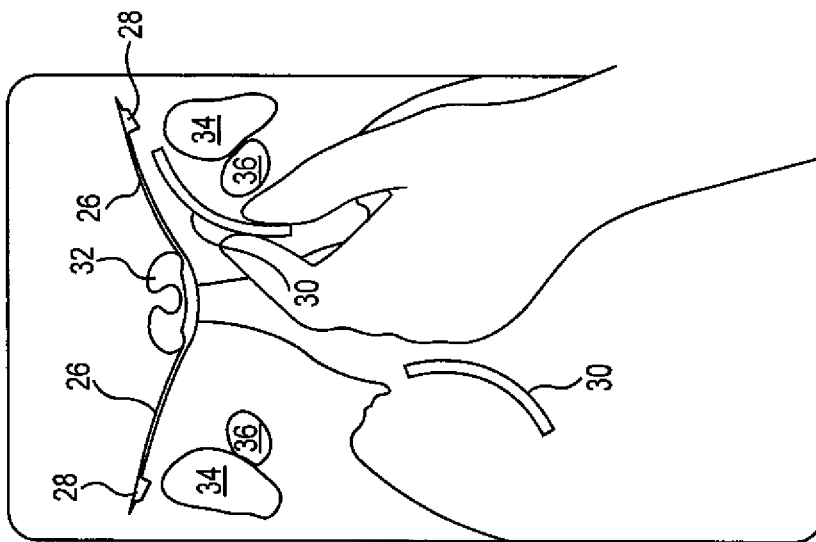
1. USE INSERTION TOOL TO POSITION ANCHOR.

Fig. 2A



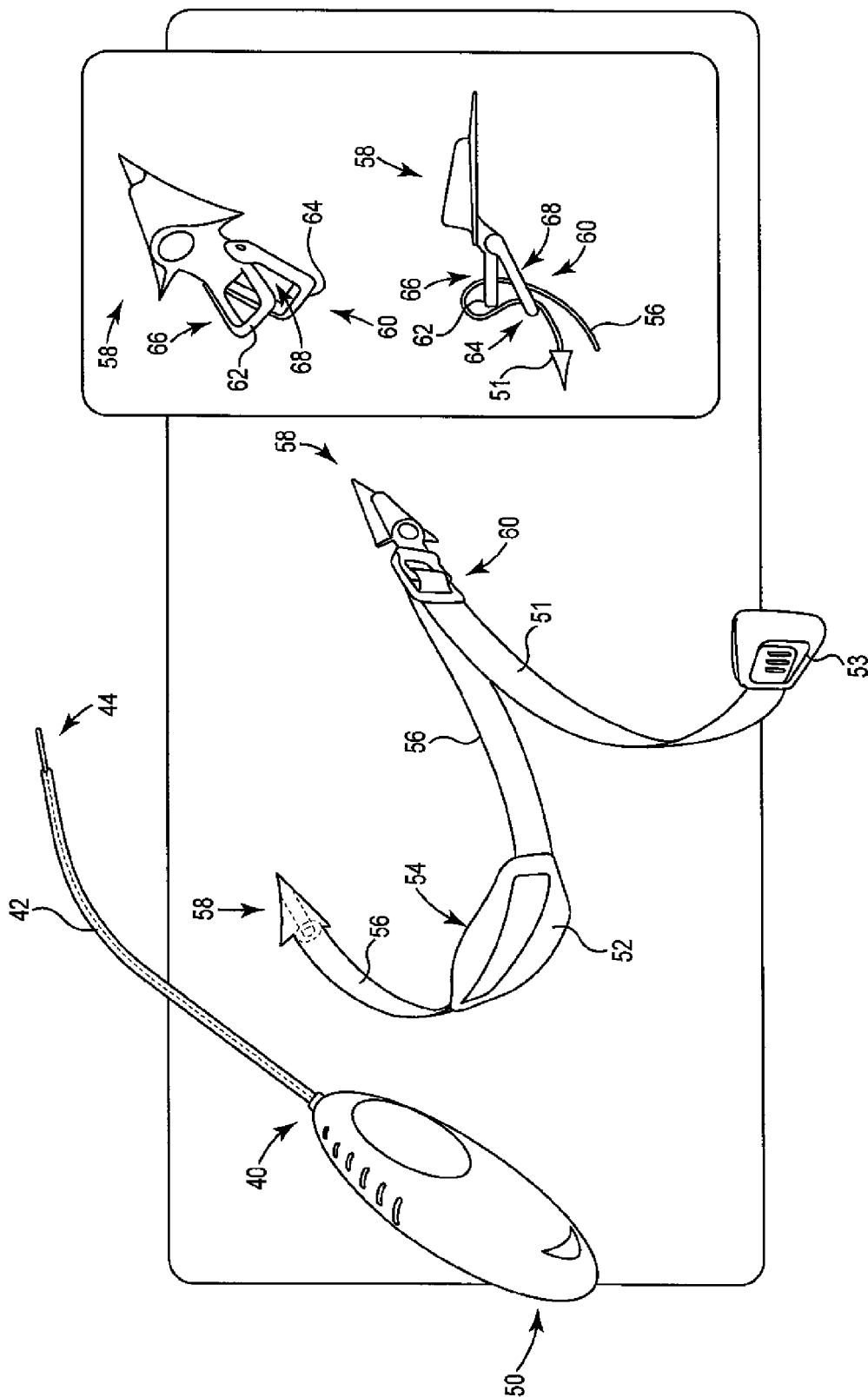
2. USE GUIDE TUBES TO RE-ENGAGE ANCHOR UNTIL SLING IS CORRECTLY POSITIONED.

Fig. 2B

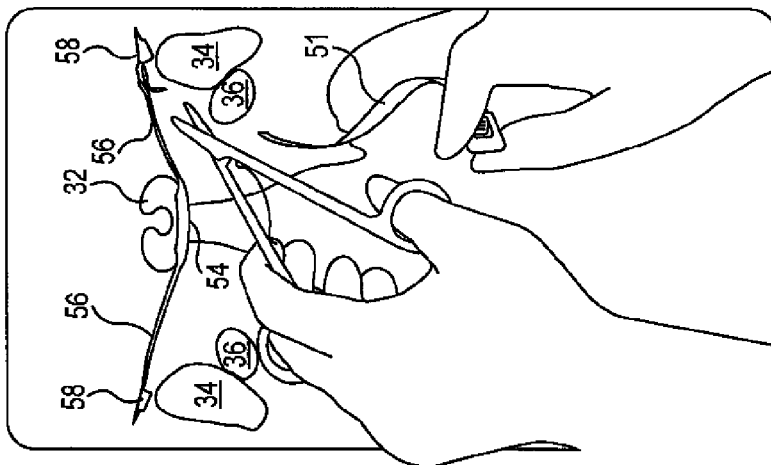


3. PULL OUT GUIDE TUBES.

Fig. 2C

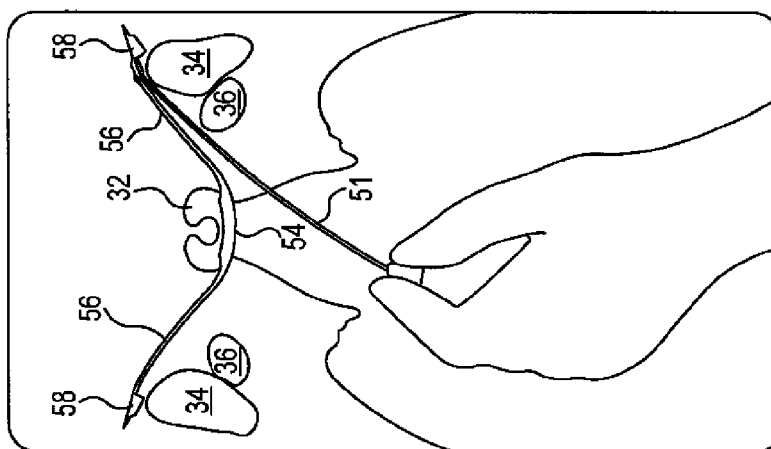


Fi. 3



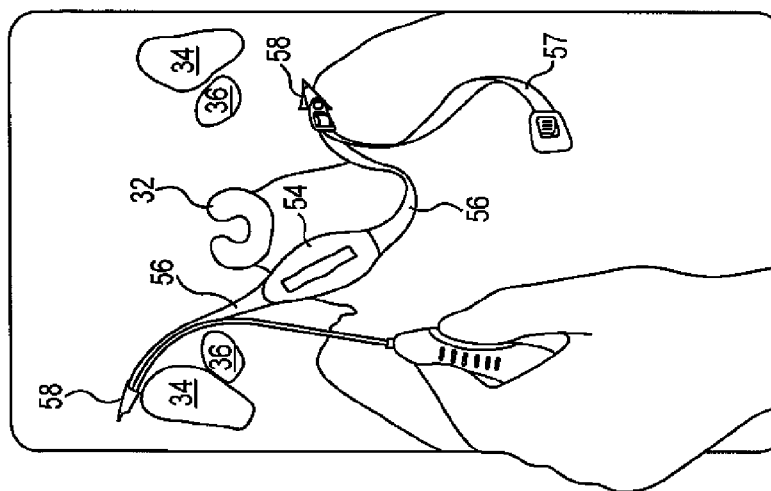
3. TRIM EXCESS MATERIAL.

Fig. 4C



2. PULL MESH THROUGH BUCKLE TO TIGHTEN SLING - REPOSITION SLING AS NECESSARY.

Fig. 4B



1. USE INSERTION TOOL TO POSITION ANCHORS.

Fig. 4A

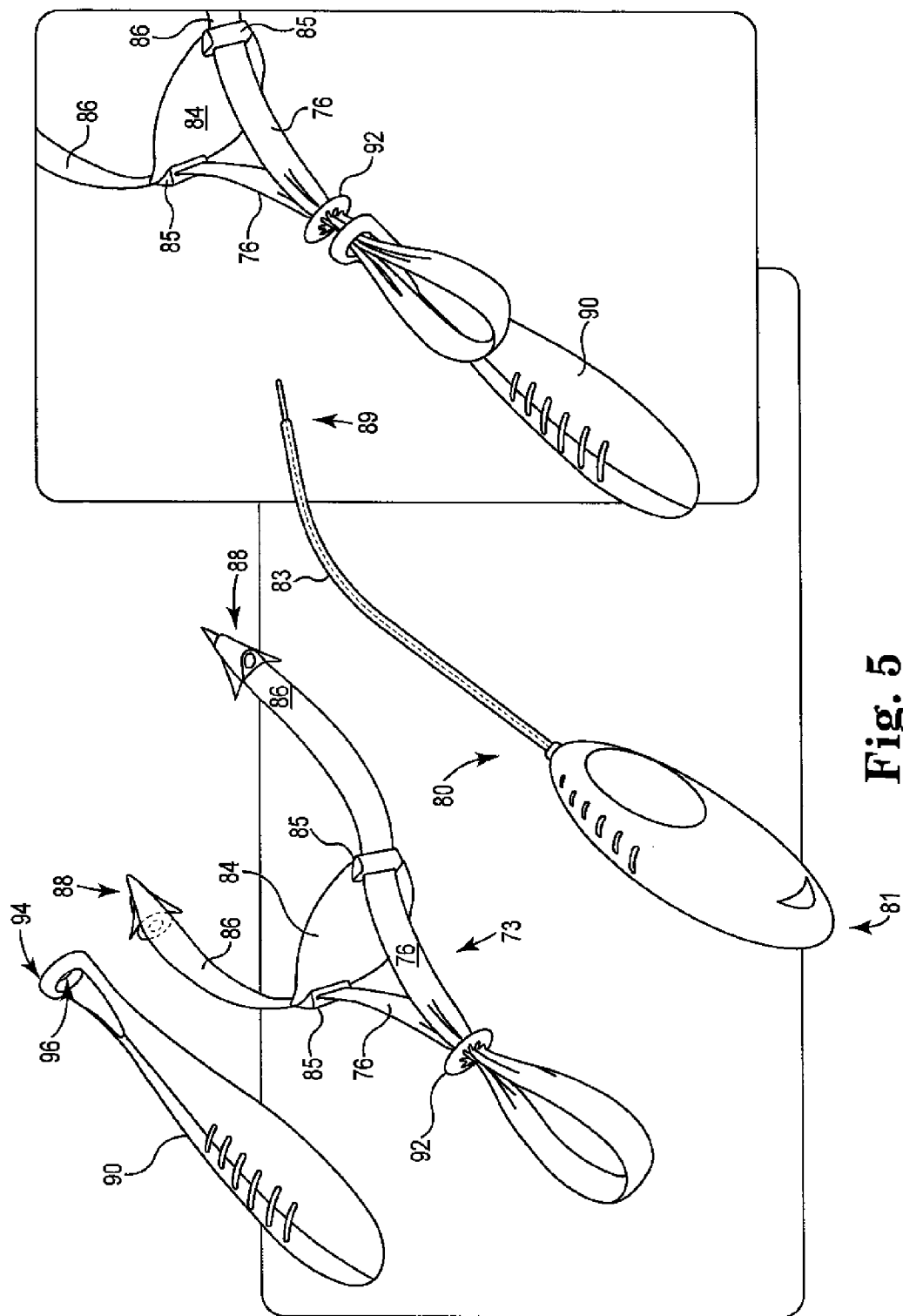
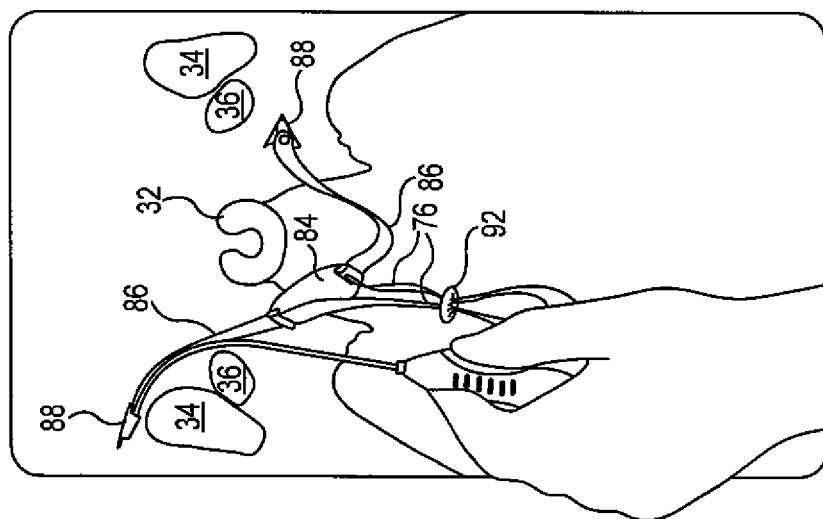
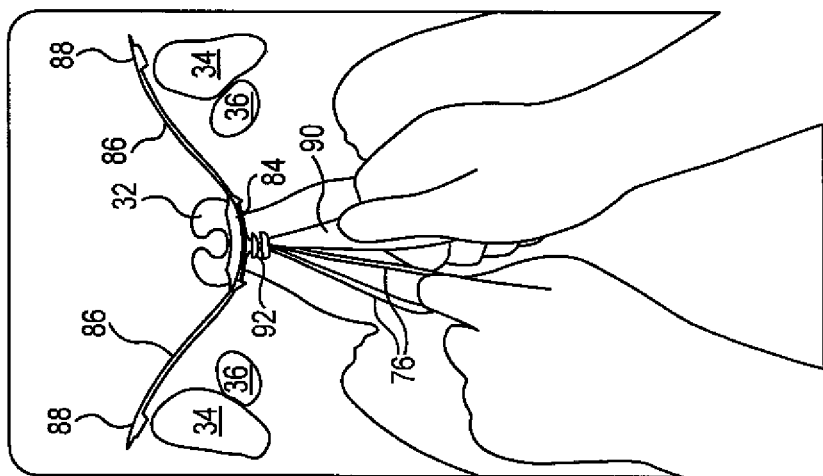


Fig. 5



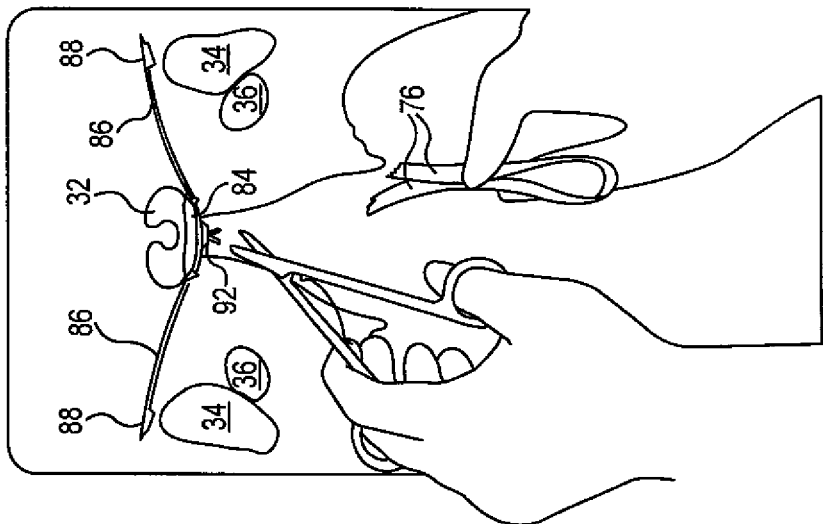
1. USE INSERTION TOOL TO POSITION ANCHORS.

Fig. 6A



2. POSITION SLING OVER URETHRA AND SLIDE CLEAT TO SECURE IN POSITION.

Fig. 6B



3. TRIM EXCESS MATERIAL.

Fig. 6C

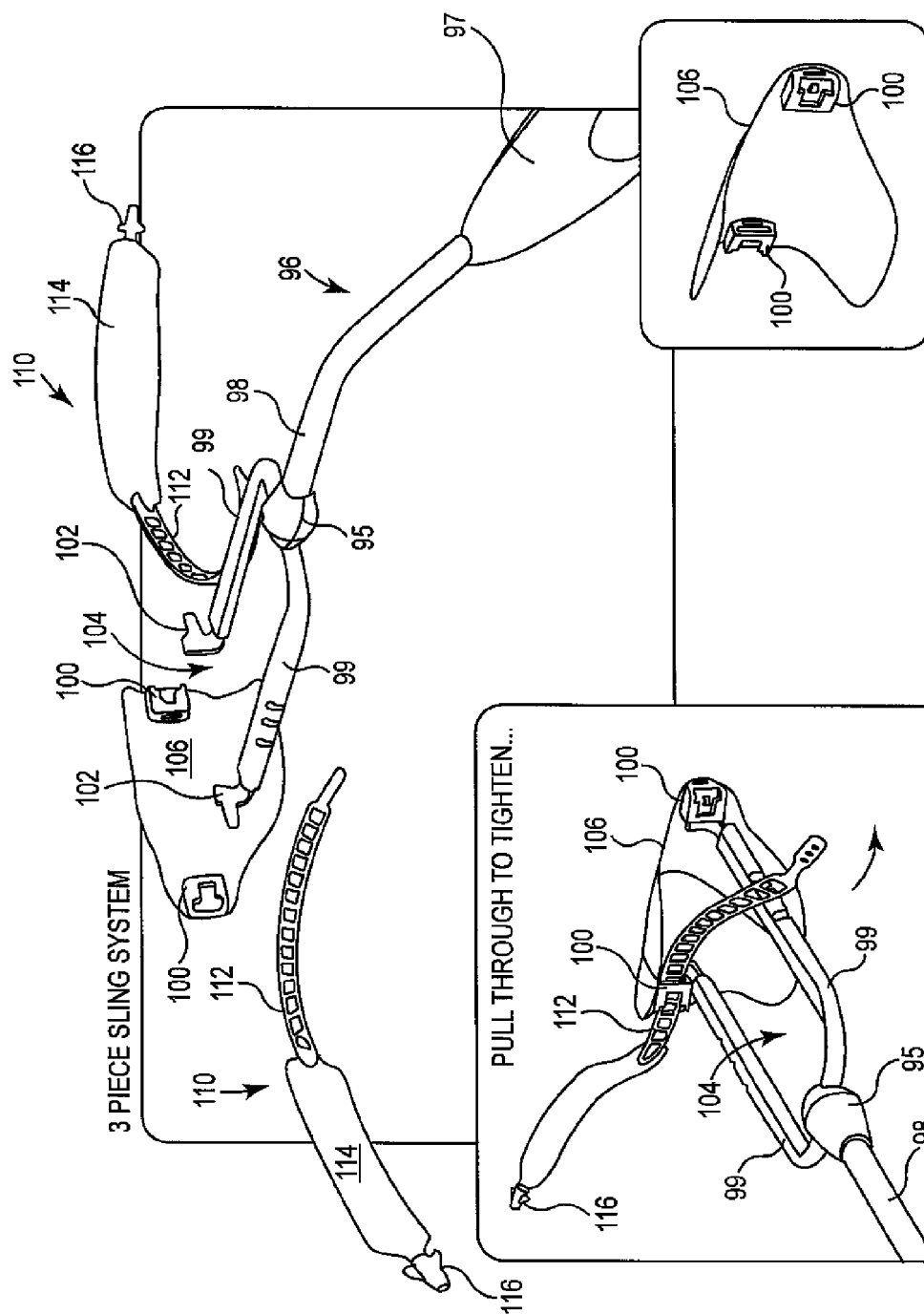
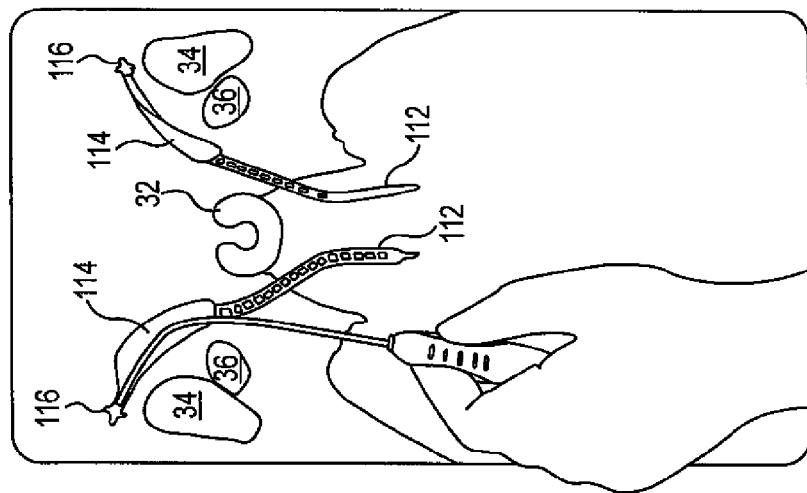
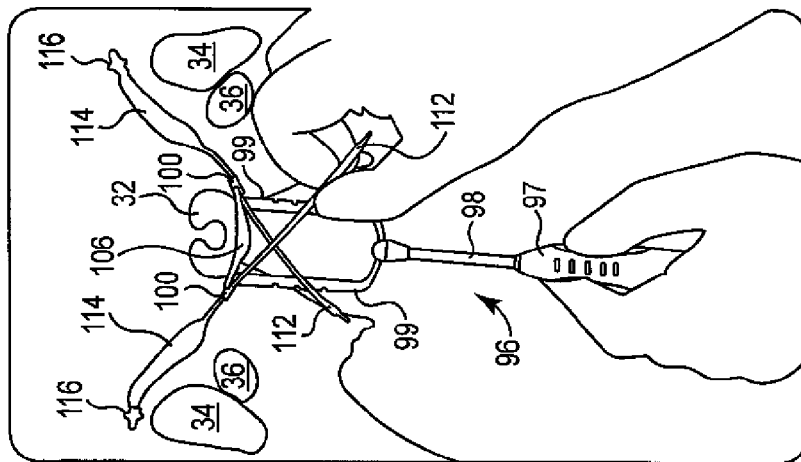


Fig. 7



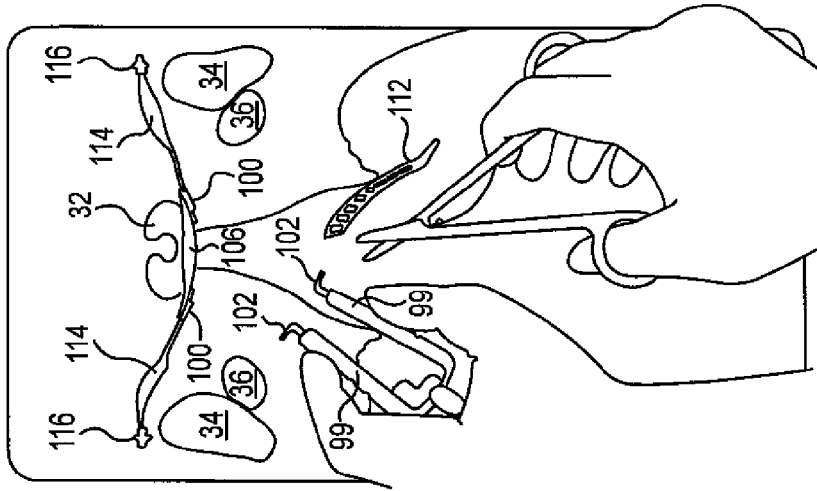
1. USE INSERTION TOOL TO POSITION ANCHORS.
2. LOAD SLING ON PUSHER TOOL.

Fig. 8A



3. PULL ANCHOR TABS THROUGH RATCHET FEATURES ON SLING AND TIGHTEN.

Fig. 8B



4. SQUEEZE PUSHER TOOL TO RELEASE SLING.
5. TRIM EXCESS MATERIAL.

Fig. 8C

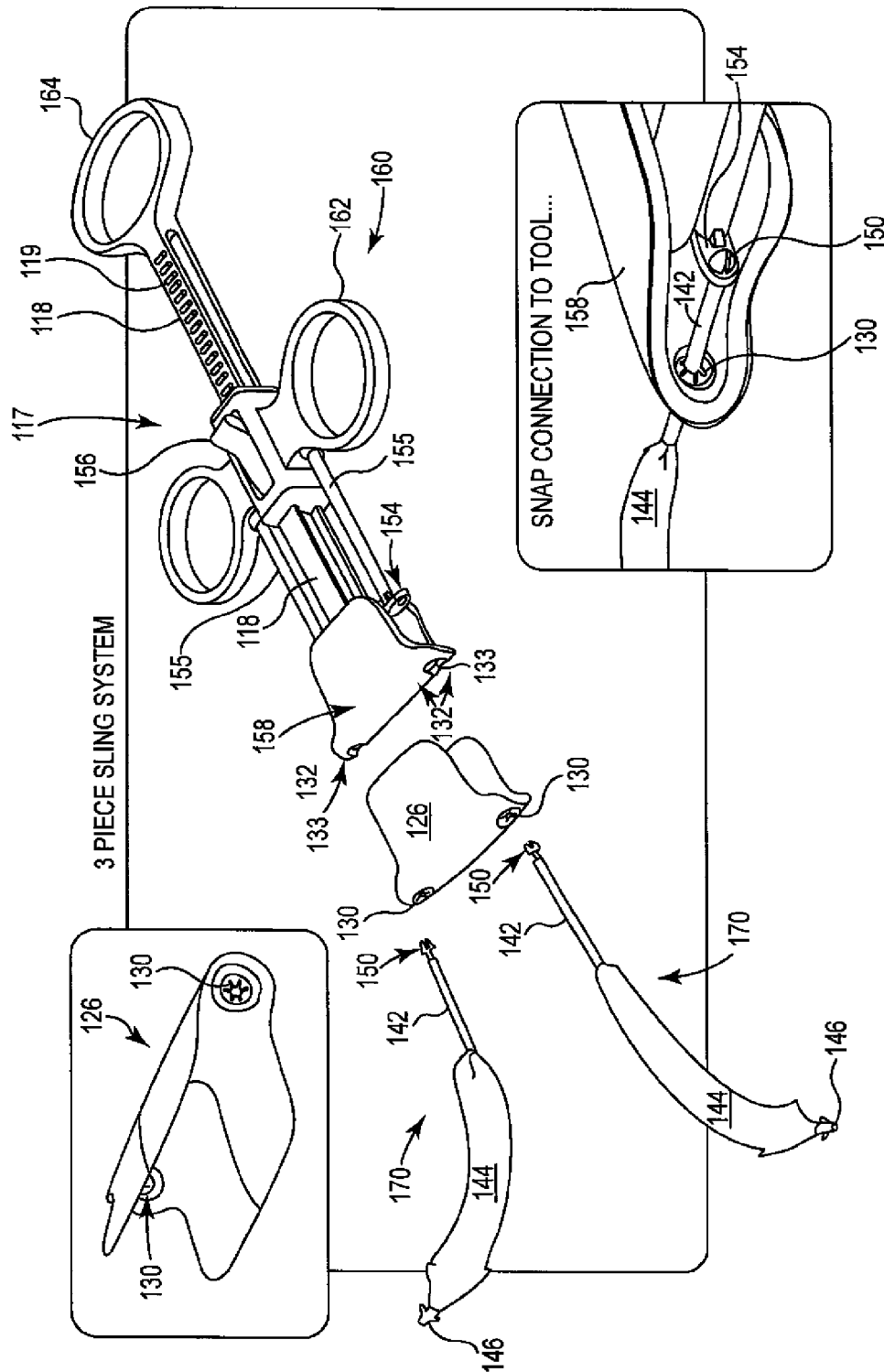


Fig. 9A

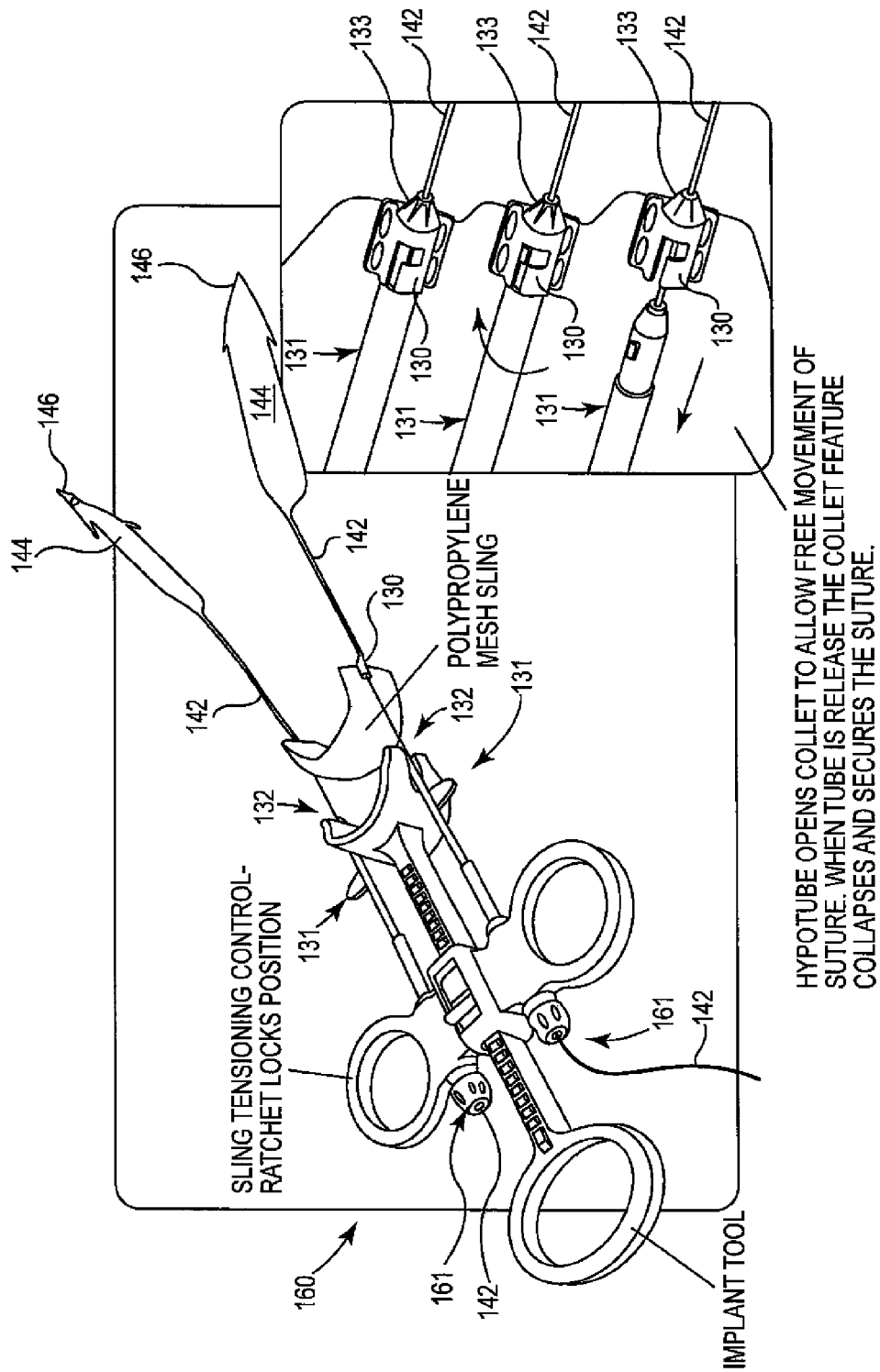
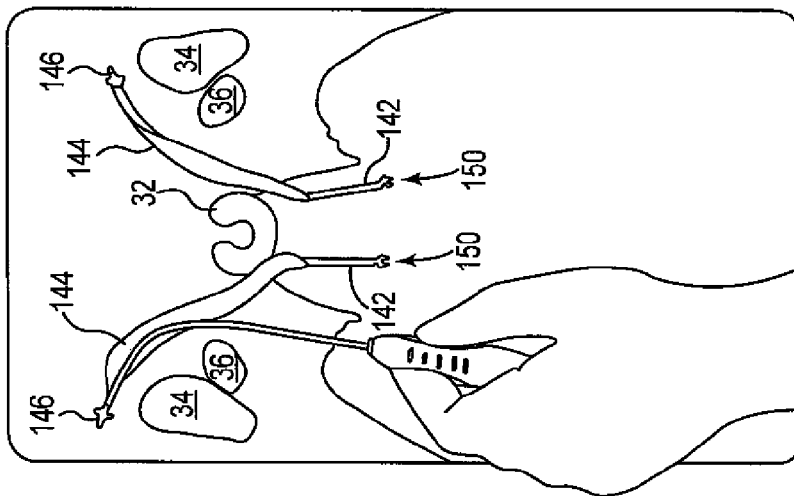
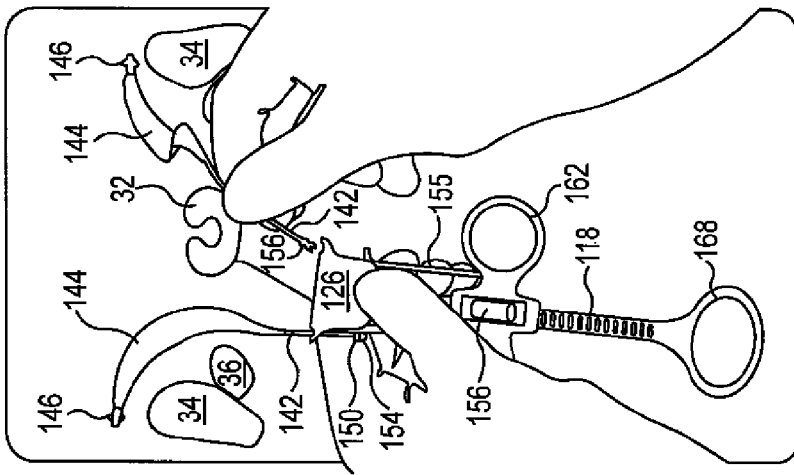


Fig. 9B



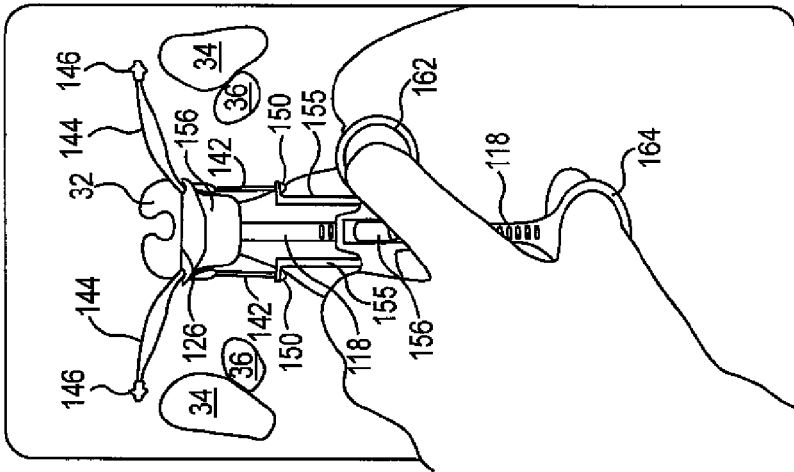
1. USE INSERTION TOOL TO POSITION ANCHORS.

Fig. 10A



2. CONNECT ANCHOR TABS TO DELIVERY TOOL.

Fig. 10B



3. PUSH/PULL ON DELIVERY TOOL TO TIGHTEN AND POSITION SLING.
4. TRIM EXCESS MATERIAL AND REMOVE TOOL.

Fig. 10C

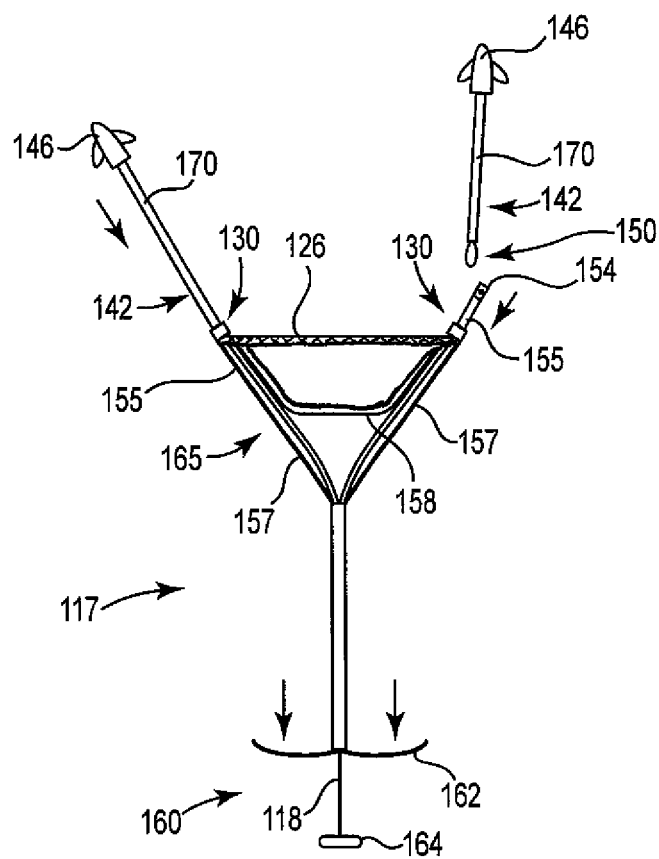


Fig. 10D

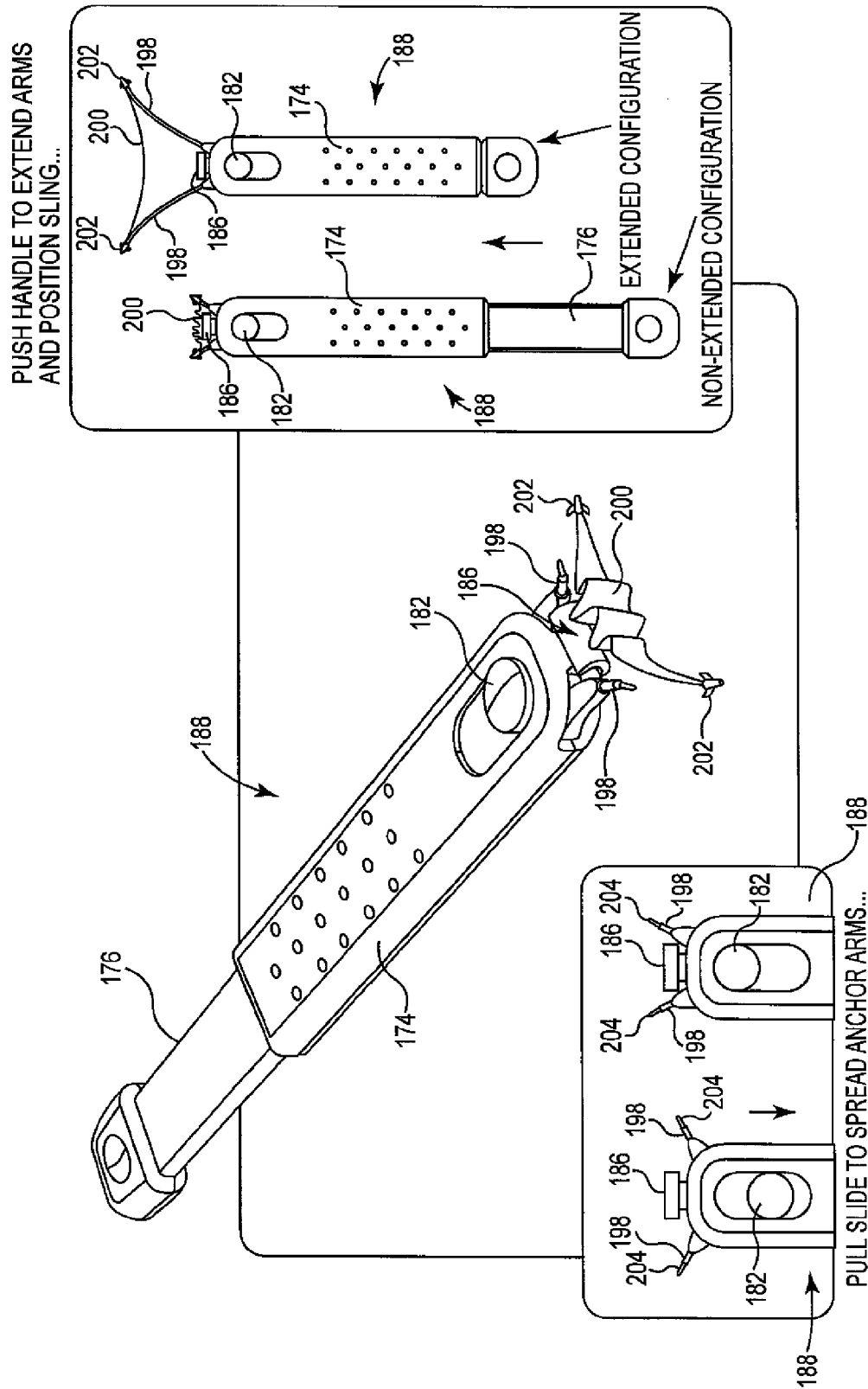
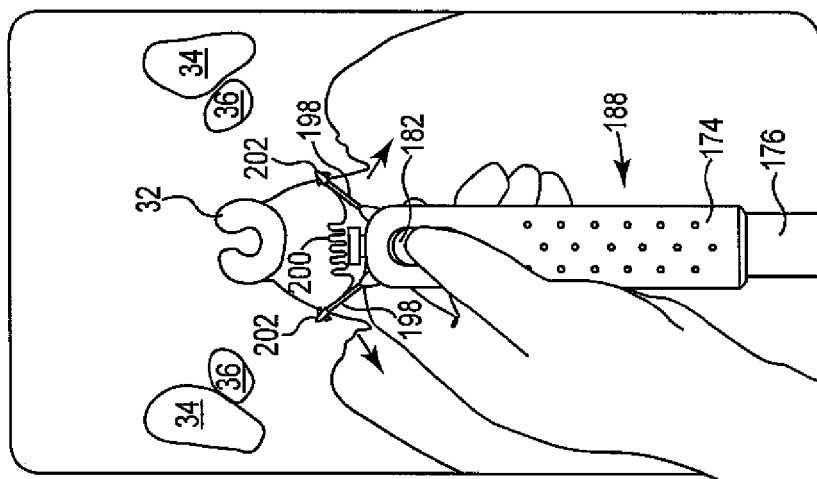
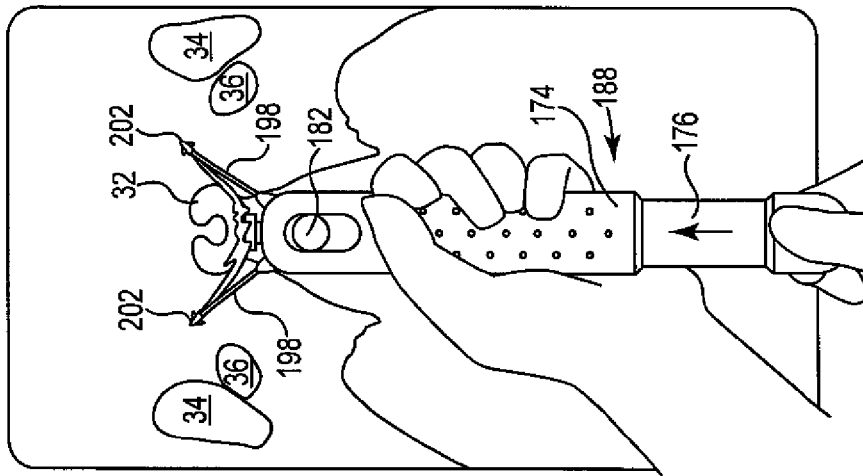


Fig. 11



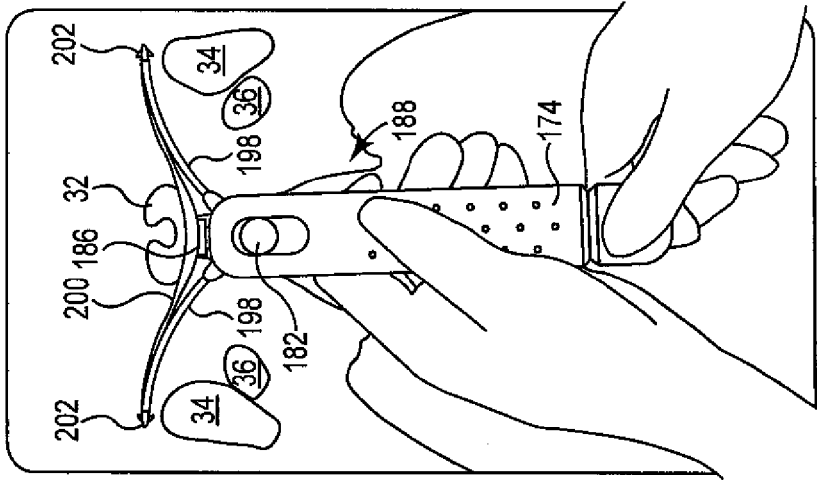
1. LOAD SLING ON DELIVERY TOOL.
2. ADJUST ANGLE OF ANCHOR POINTS PER PATIENT ANATOMY.

Fig. 12A



3. HOLD DELIVERY TOOL AGAINST URETHRA AND ADVANCE ANCHOR INSERTION ARMS.

Fig. 12B



4. CONTINUE TO ADVANCE UNTIL ARMS ARE FULLY EXTENDED AND SLING IS CORRECTLY POSITIONED.
5. REMOVE DELIVERY TOOL.

Fig. 12C

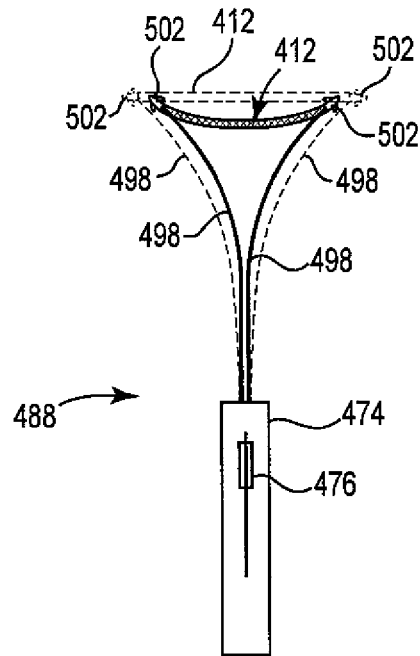


Fig. 12D

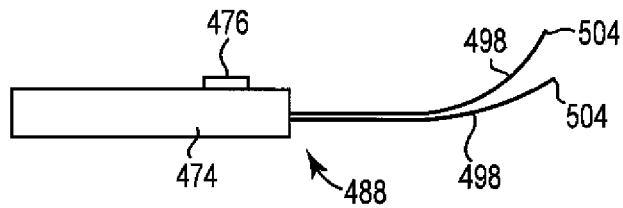


Fig. 12E

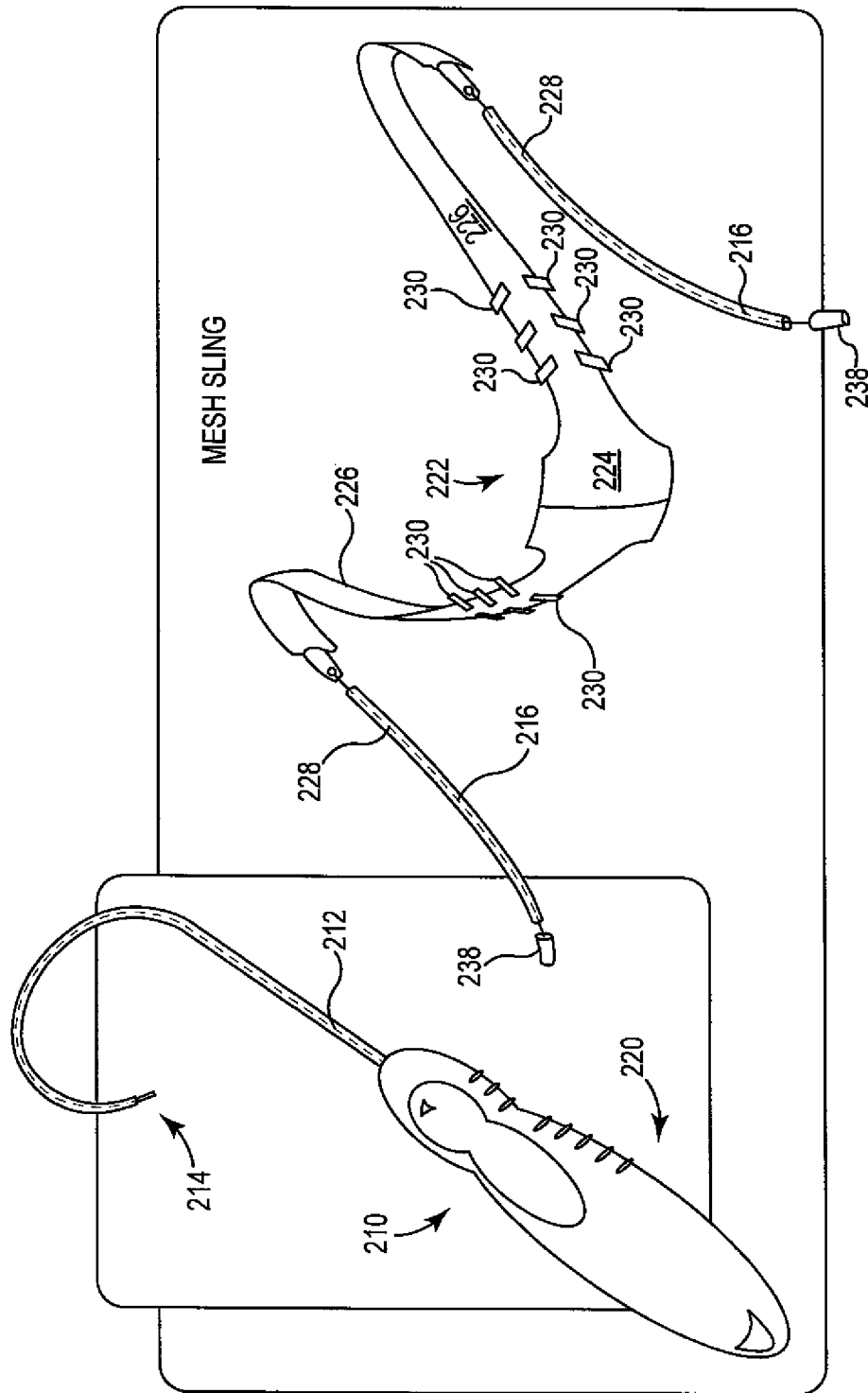
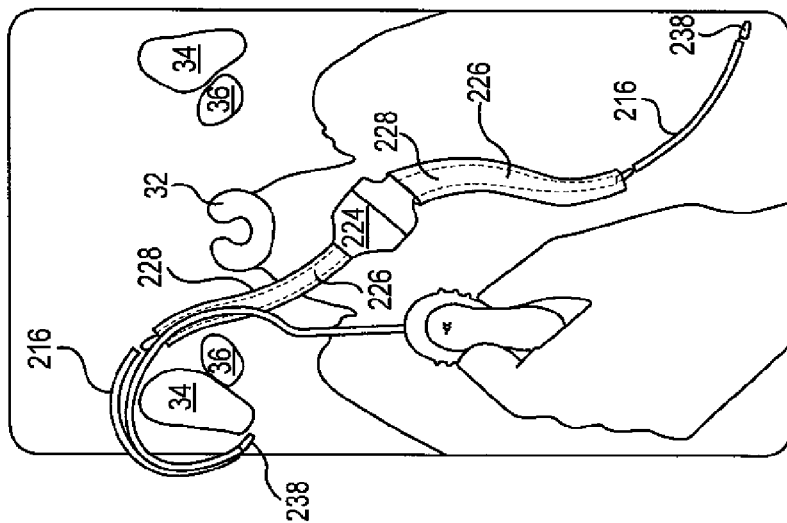
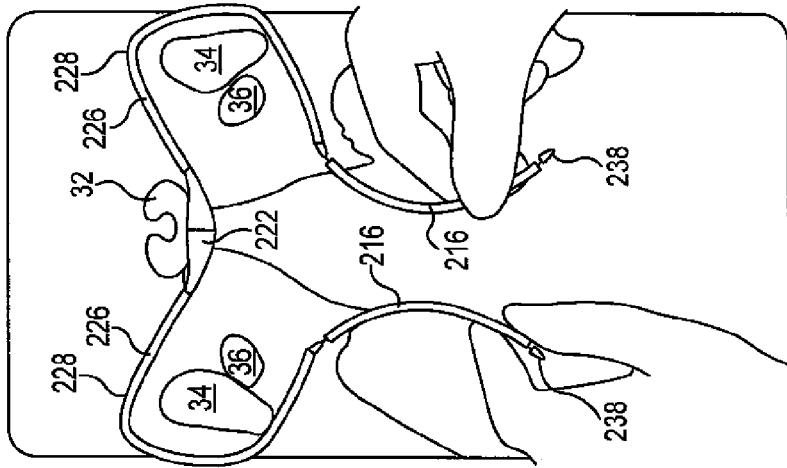


Fig. 13



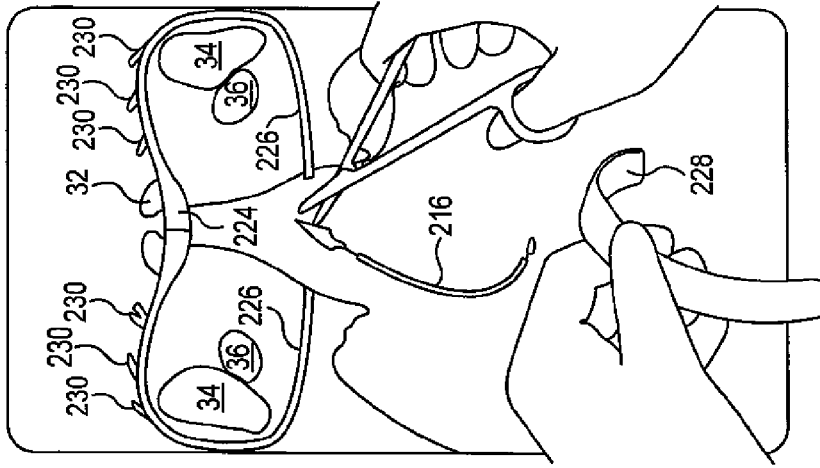
1. USE HELICAL INSERTION TOOL
PASS THE ANCHOR AROUND
THE PUBIC RAMUS AND
SUBCUTANEOUSLY BACK TO
THE MIDLINE PERINEAL REGION.

Fig. 14A



2. TENSION SLING BY PULLING
TAILS TO TIGHTEN
CORRESPONDING ARMS.

Fig. 14B



3. PULL OFF POLYETHYLENE
SHEATHS TO EXPOSE BARBS.
4. CUT ENDS TO LENGTH.

Fig. 14C

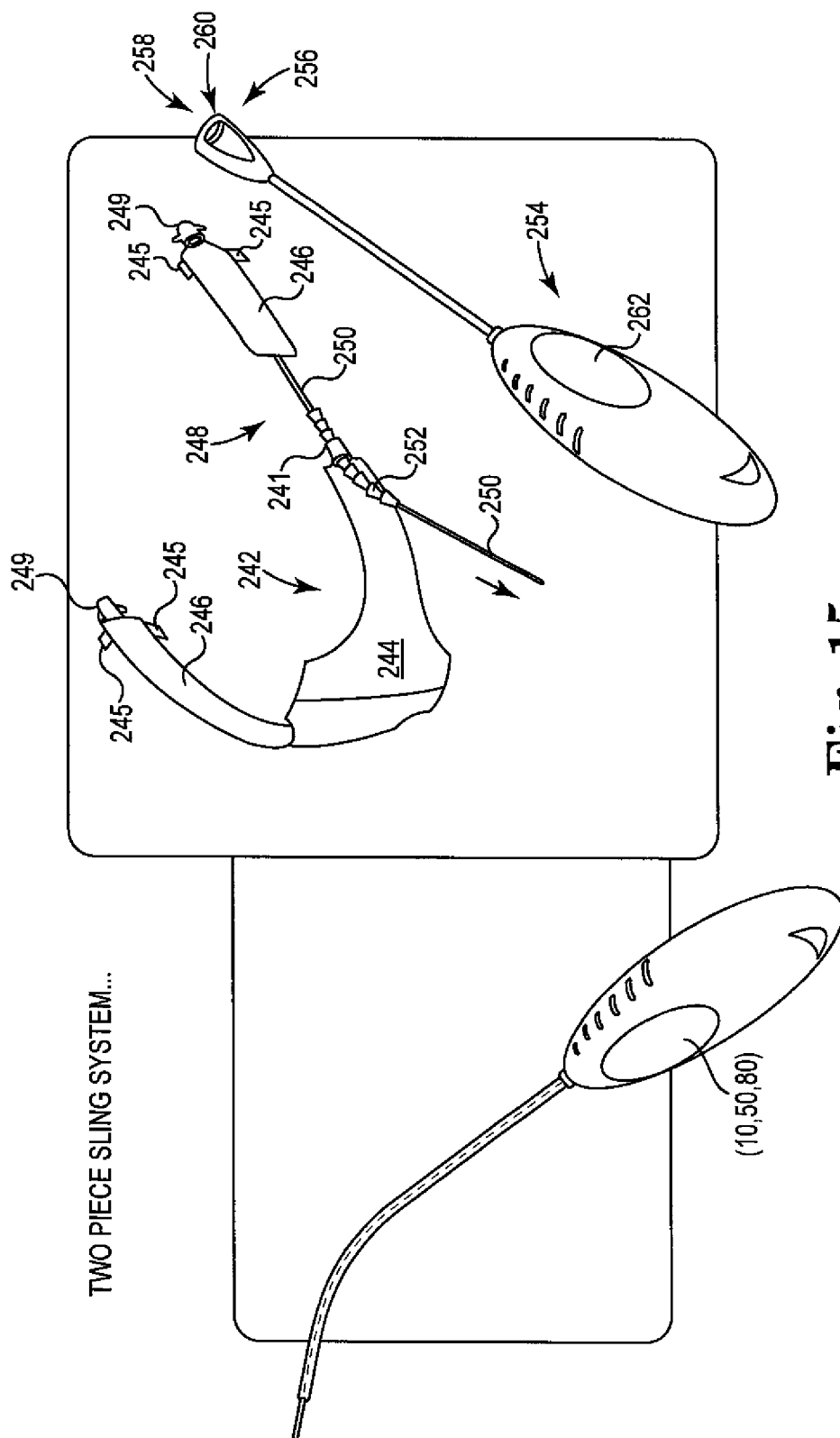
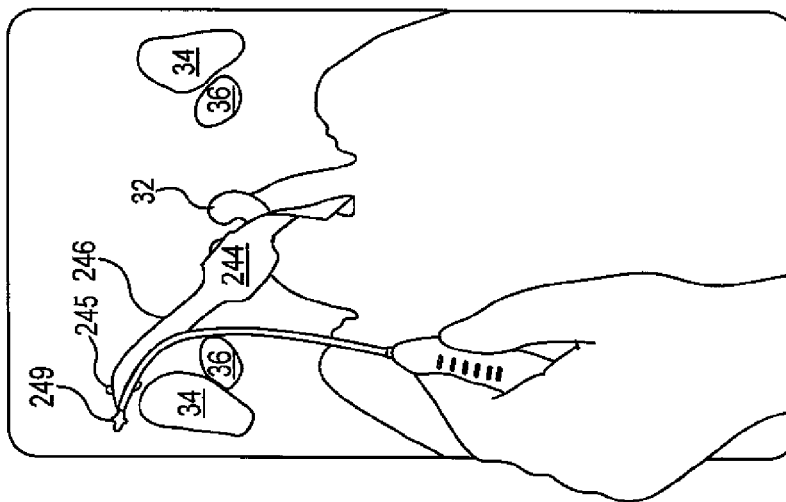
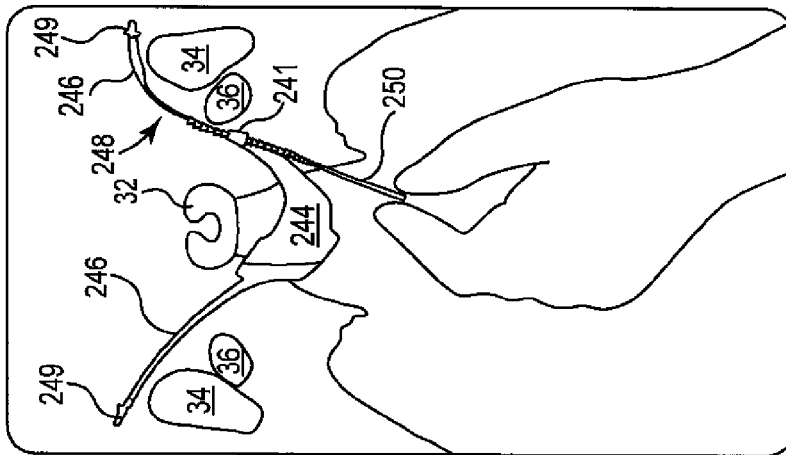


Fig. 15



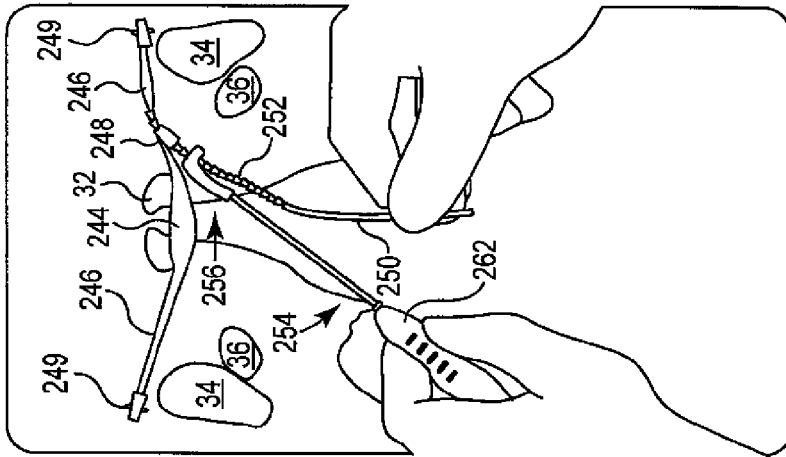
1. USE INSERTION TOOL TO
INSERT SLING PORTION OF
MESH ANCHOR.

Fig. 16A



2. INSERT ANCHOR COMPONENT
WITH "ZIP" TAIL
3. THREAD ZIP TAIL THROUGH
RATCHET ON MESH SLING.

Fig. 16B



4. USE PUSHER TOOL TO
TENSION SLING.
5. CUT ENDS TO LENGTH.

Fig. 16C

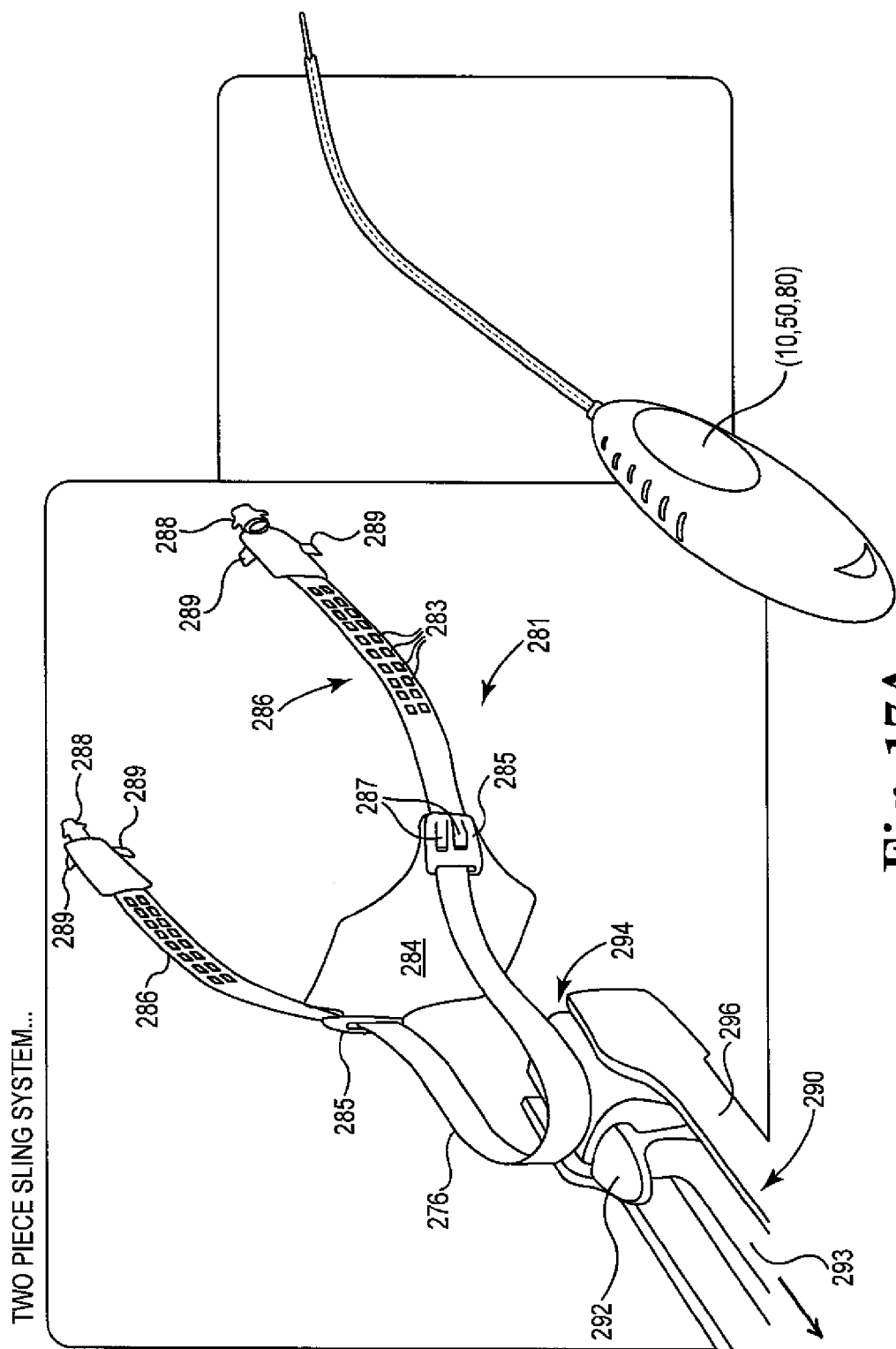


Fig. 17A

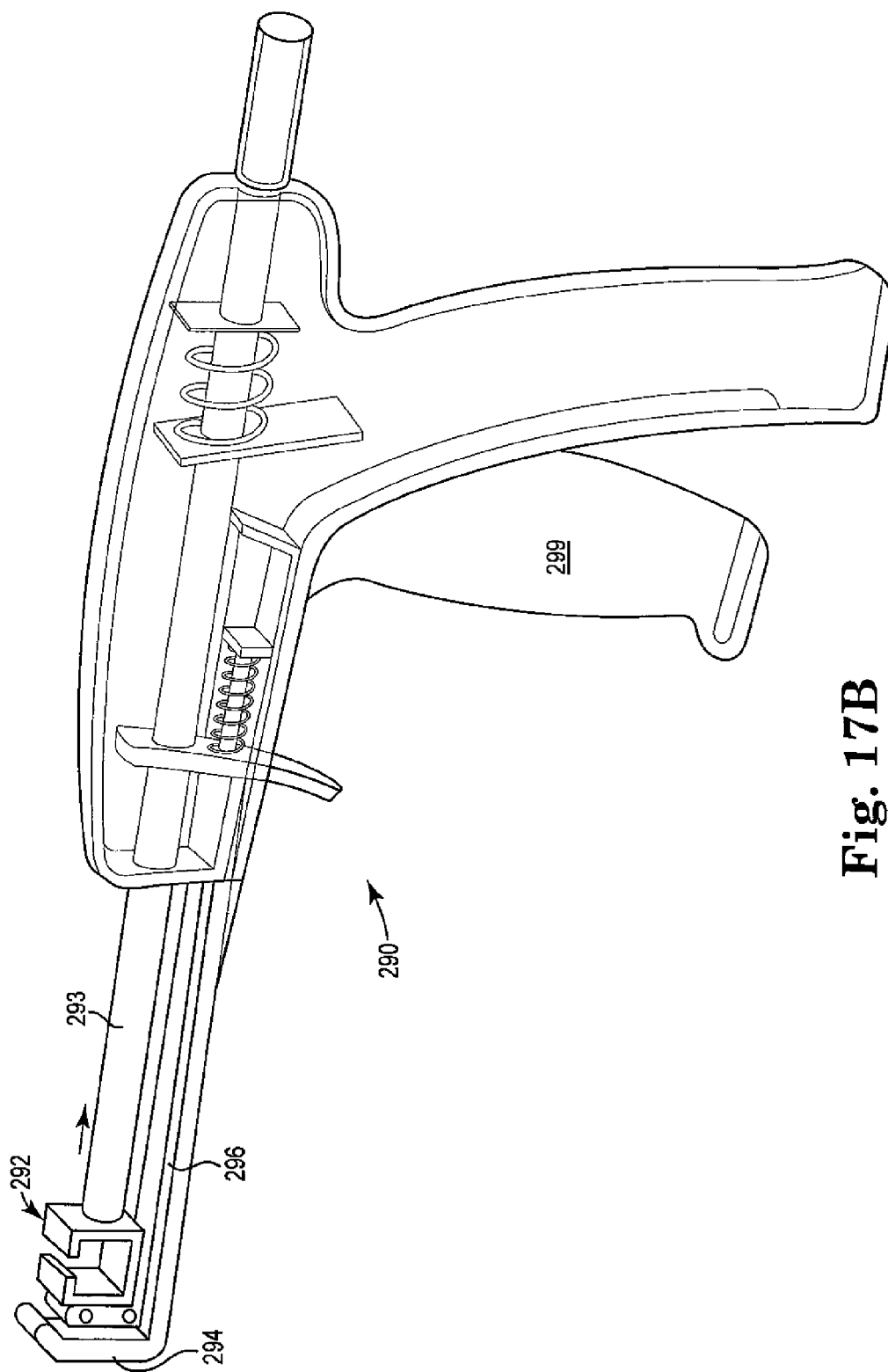


Fig. 17B

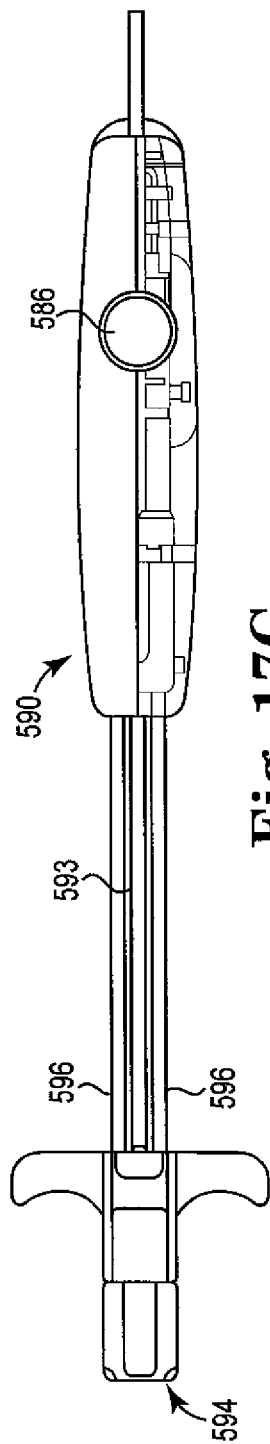


Fig. 17C

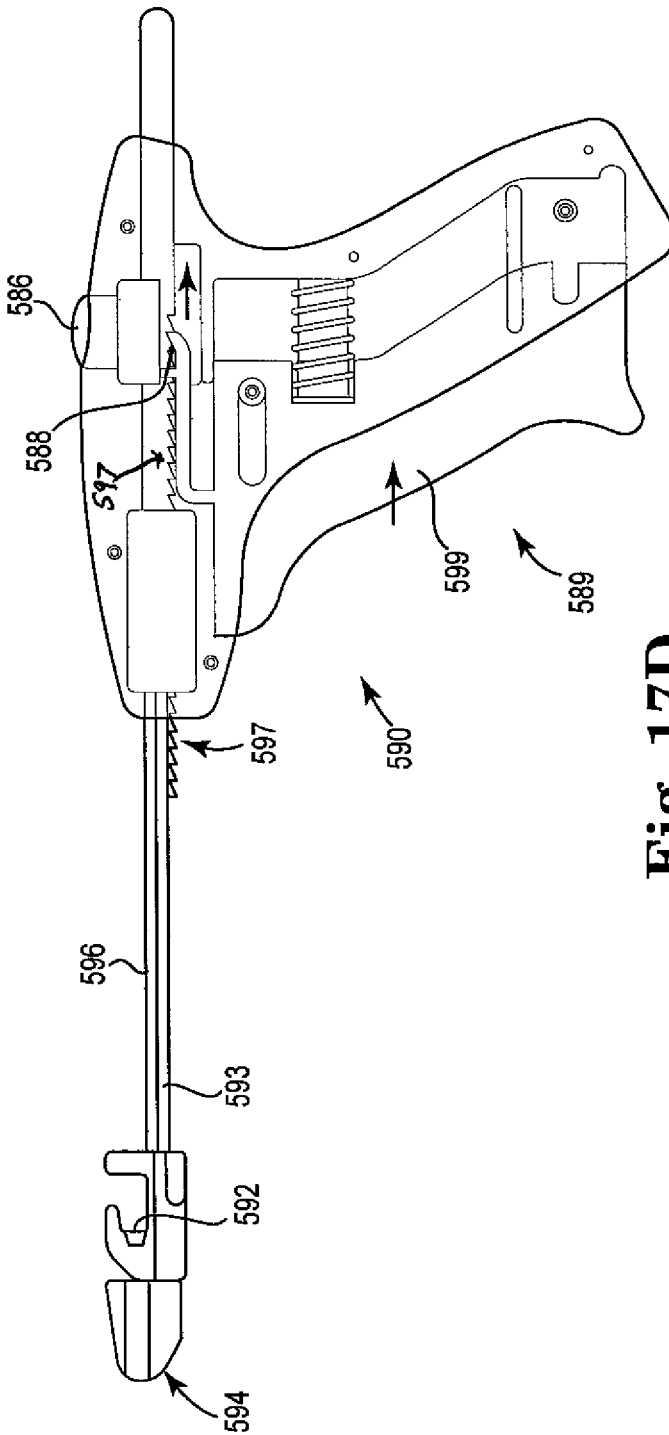


Fig. 17D

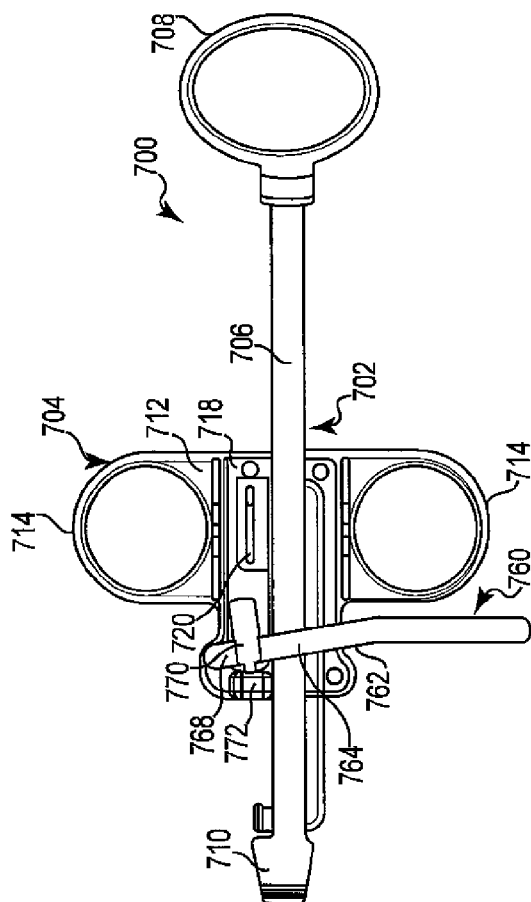


Fig. 17E

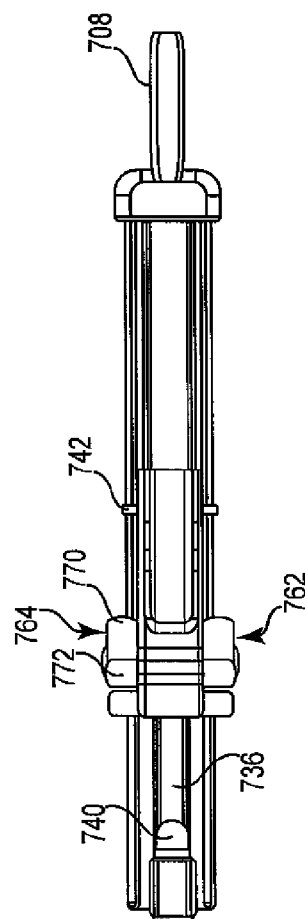


Fig. 17F

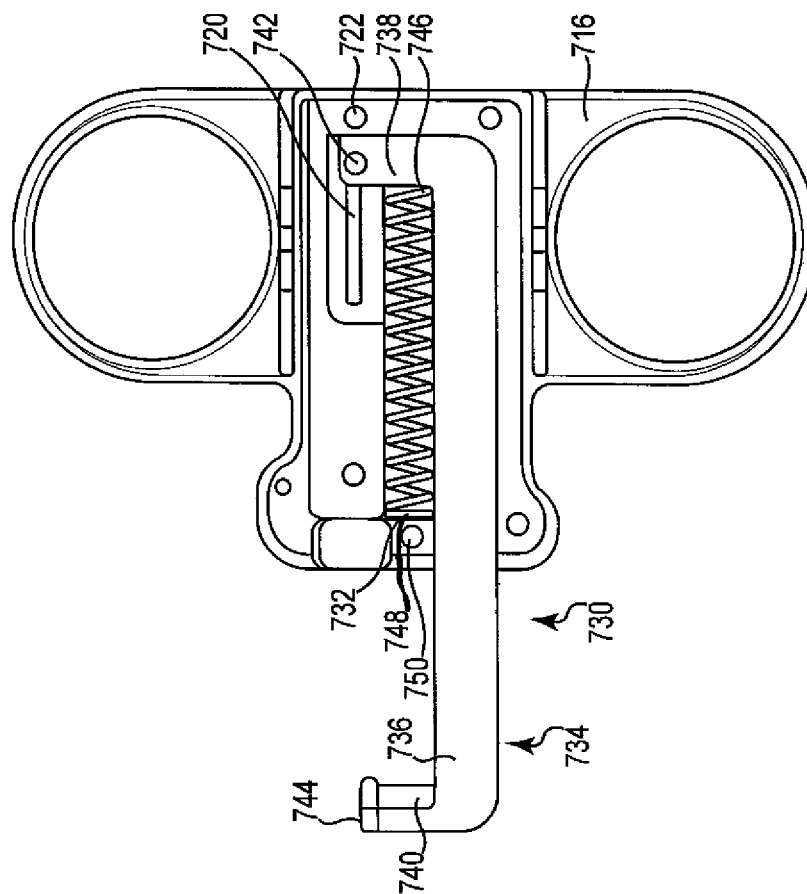
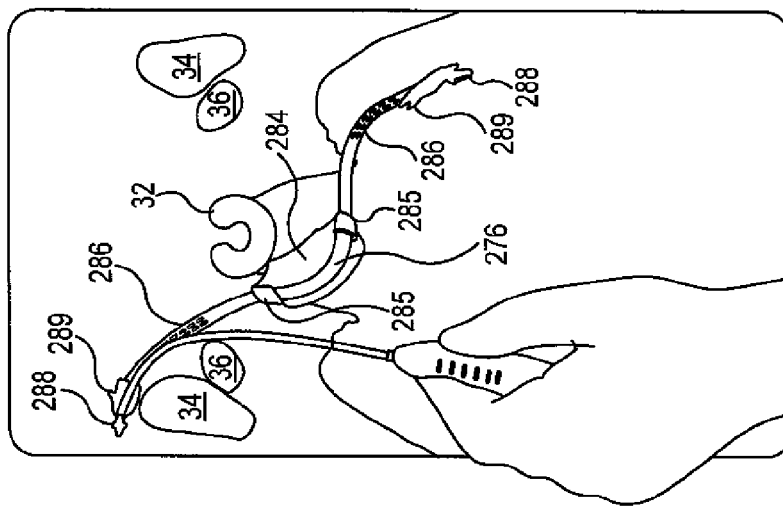
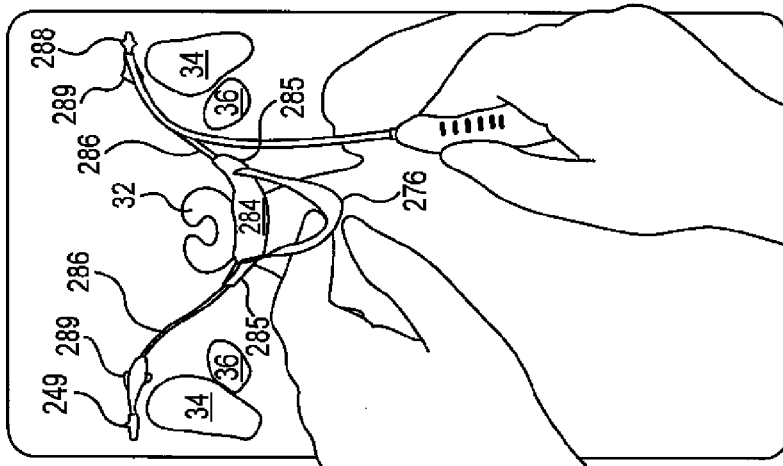


Fig. 17G



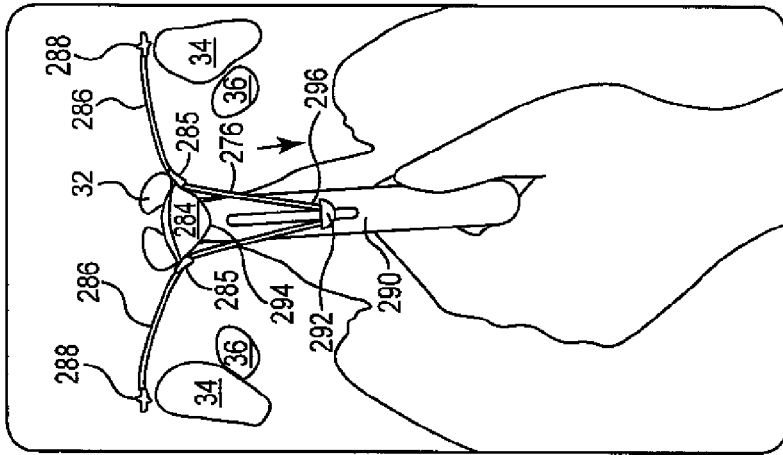
1. USE INSERTION TOOL TO INSERT ANCHOR ARMS ON EACH END OF SLING SYSTEM.

Fig. 18A



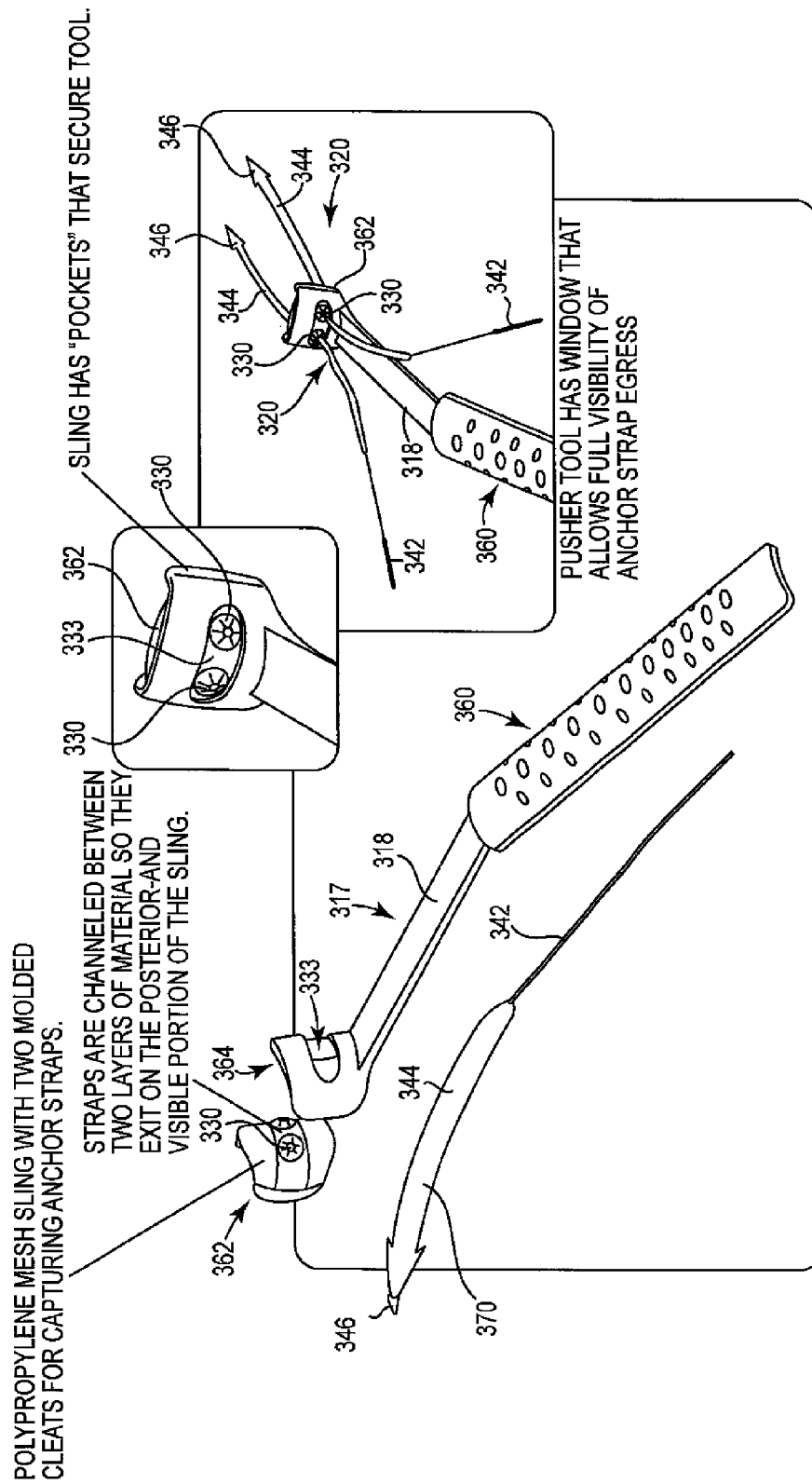
2. CENTER SLING AND CREATE A LOOP FROM ANCHOR ARMS.

Fig. 18B



3. INSERT TENSIONING TOOL AND ADJUST SLING.
4. TRIM ENDS TO LENGTH.

Fig. 18C



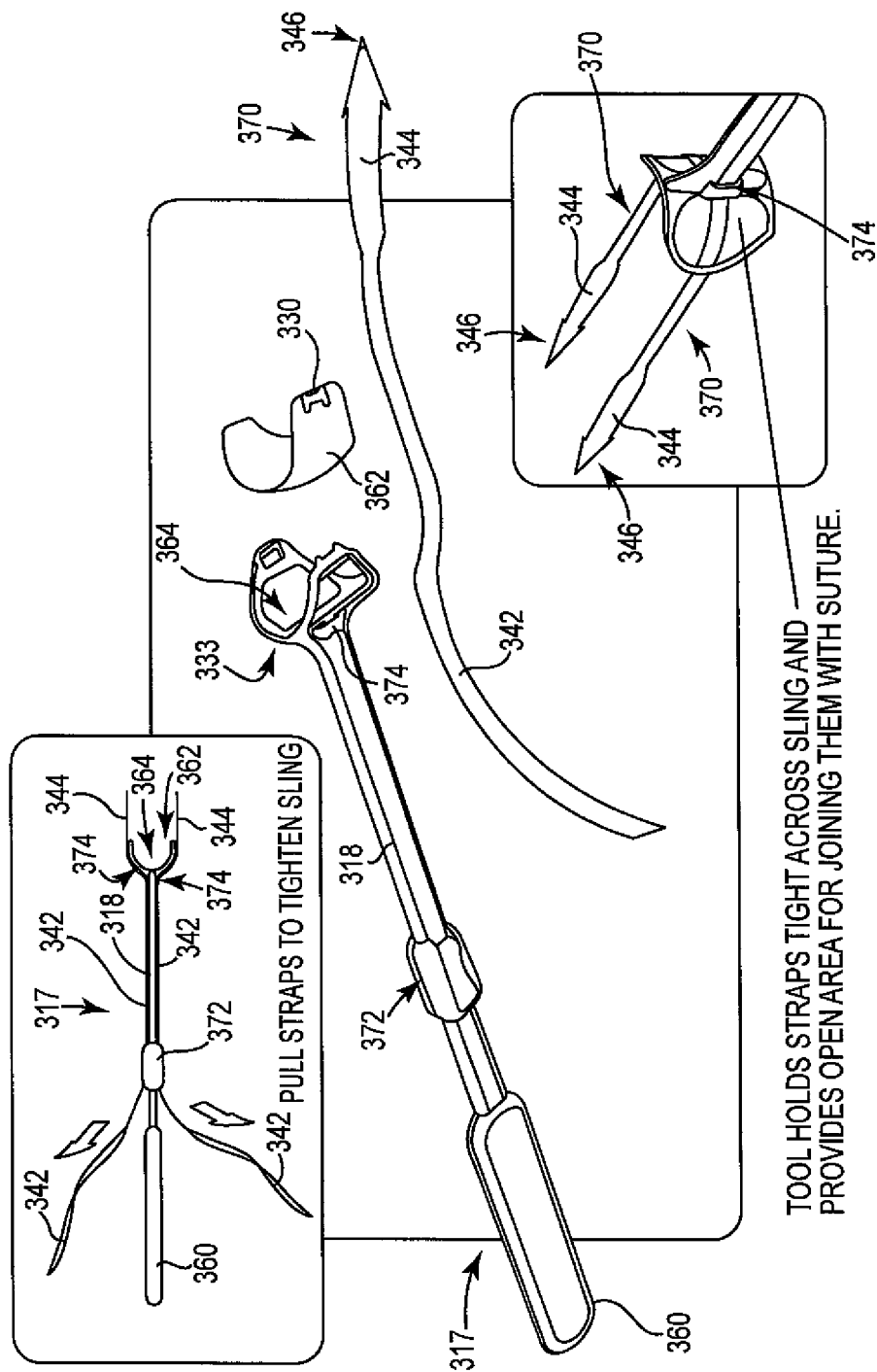
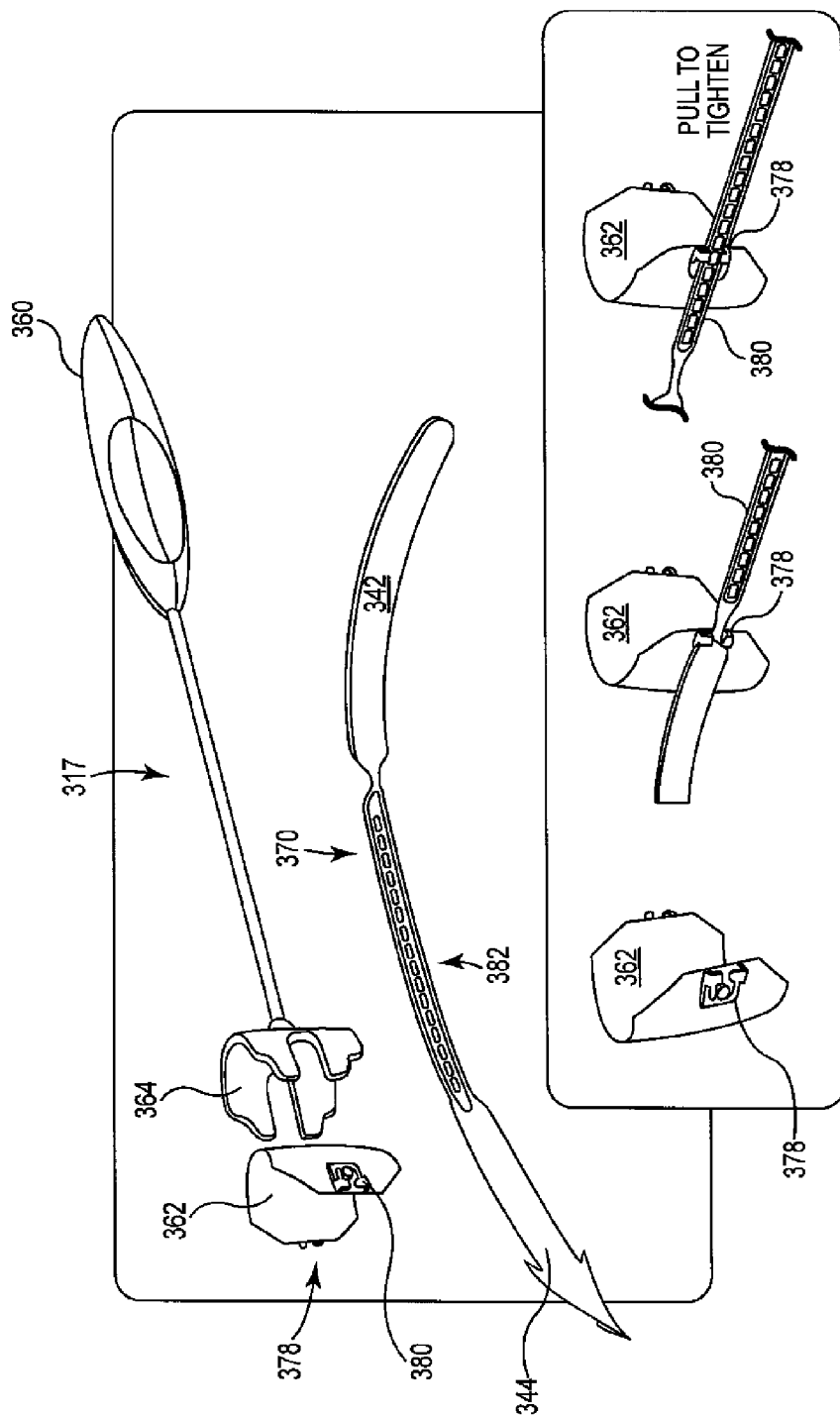


Fig. 20



STRAPS CAN BE TIGHTENED INDIVIDUALLY AND SLING POSITION CAN BE TESTED WITHOUT PUSHER TOOL IN PLACE. STRAP CAN BE LOOSENED BY FLEXING STRAP AWAY FROM BUCKLE. ONCE POSITION OF SLING IS VERIFIED, STRAPS ARE TRIMMED AND SUTURED TO SLING.

Fig. 21

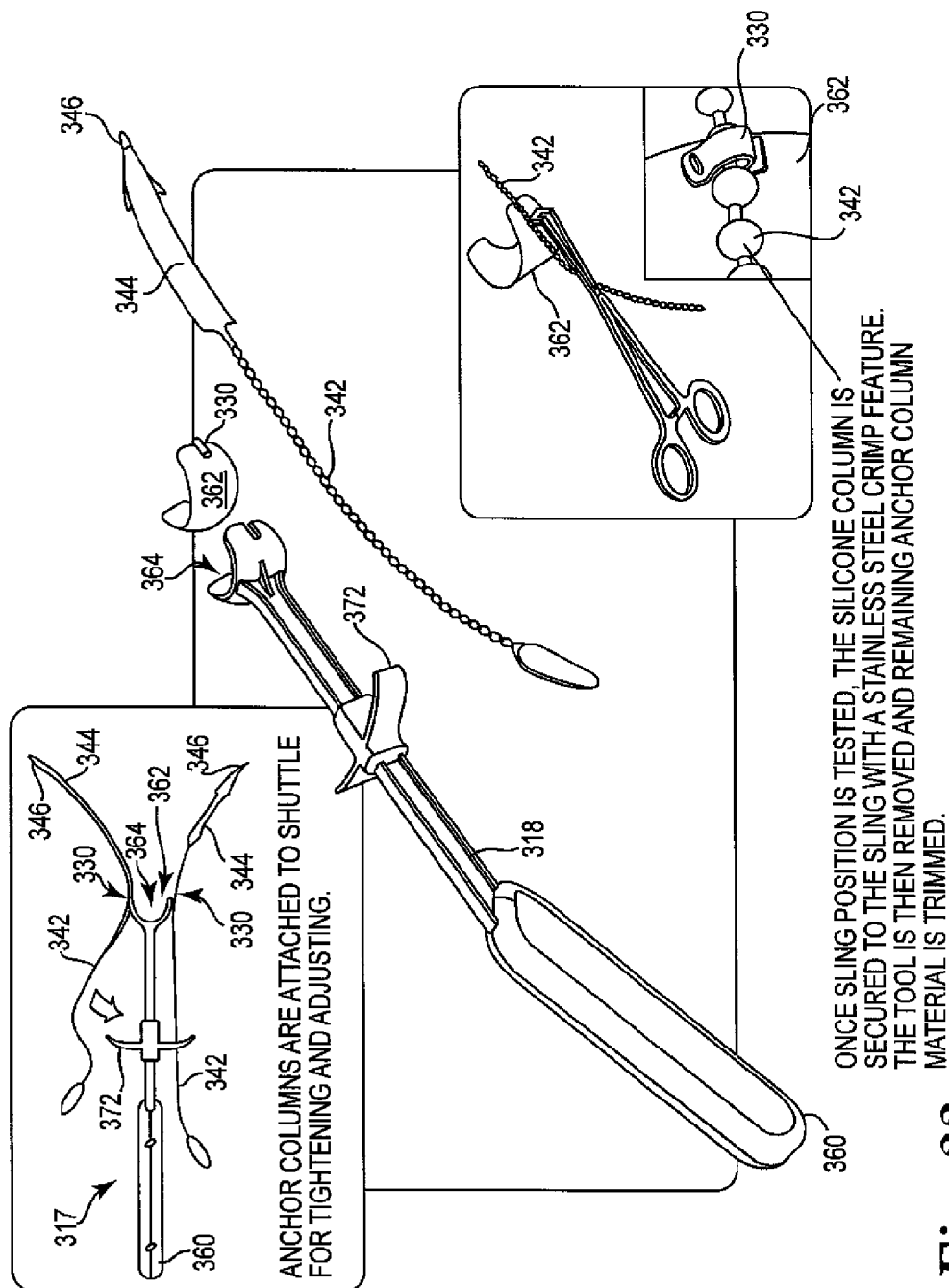


Fig. 22

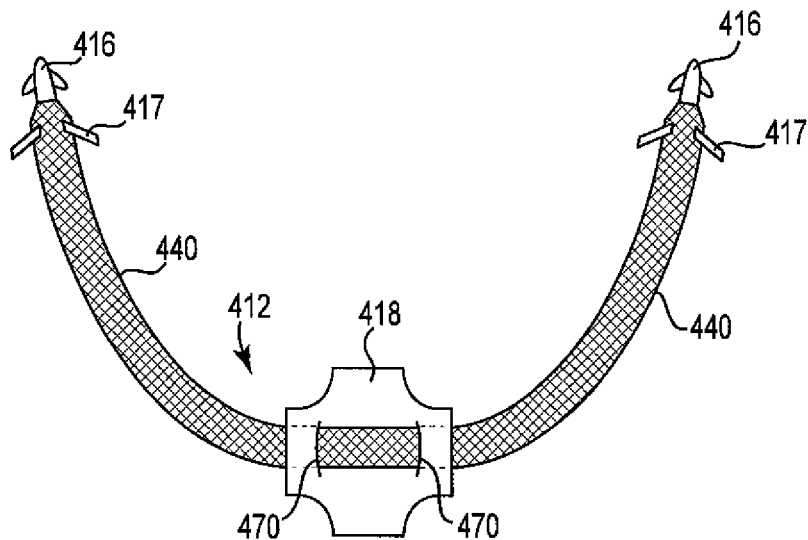


Fig. 23

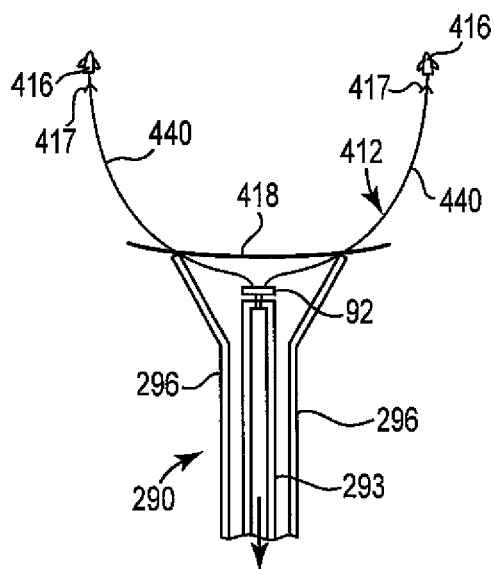


Fig. 24

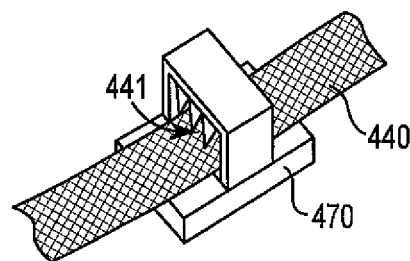
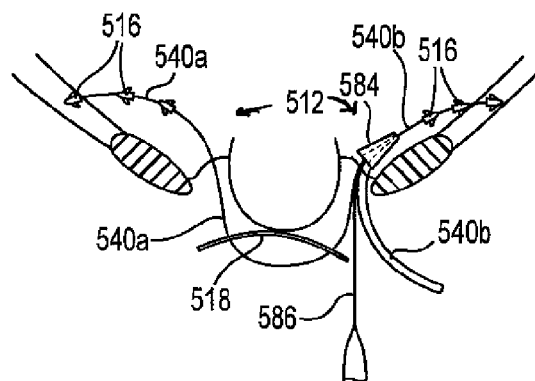
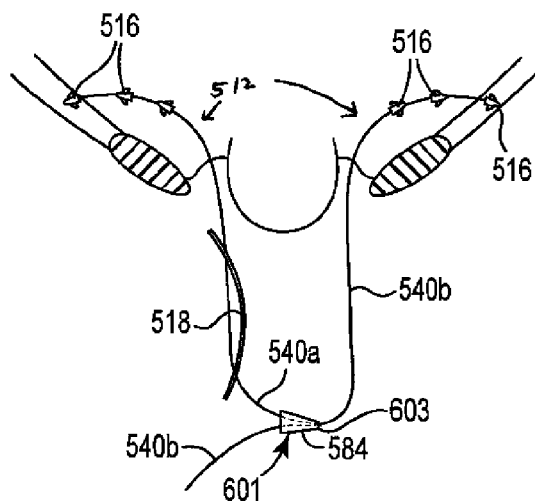
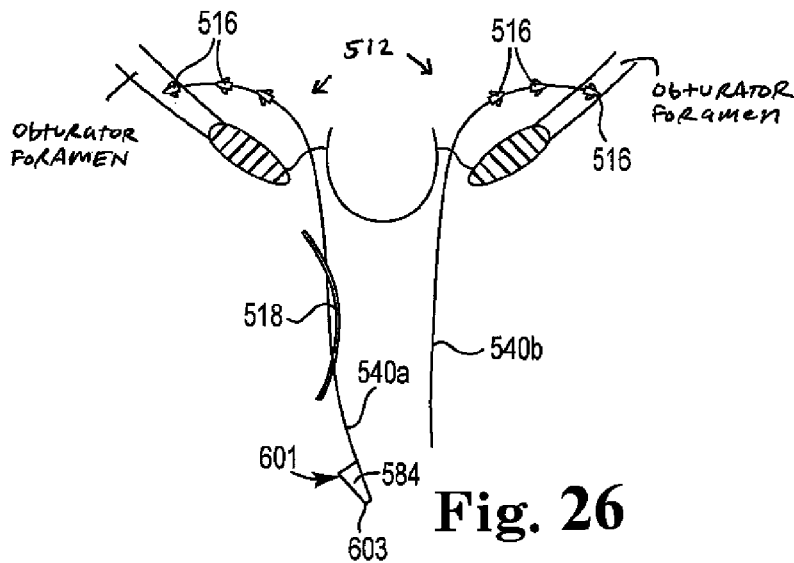


Fig. 25



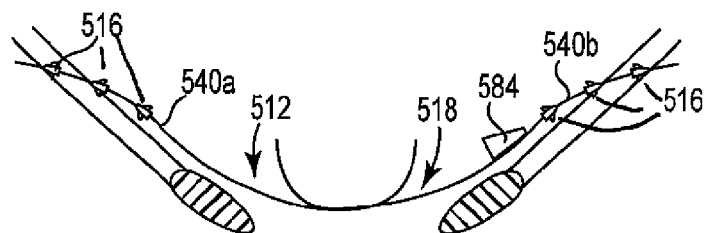


Fig. 29

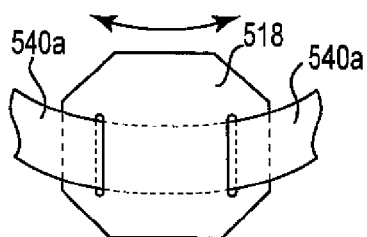


Fig. 30

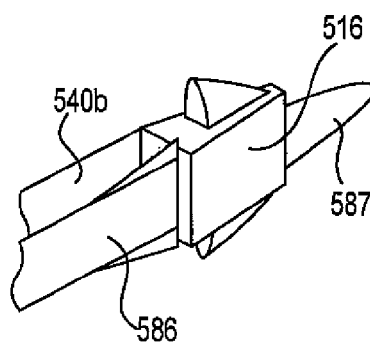


Fig. 32A

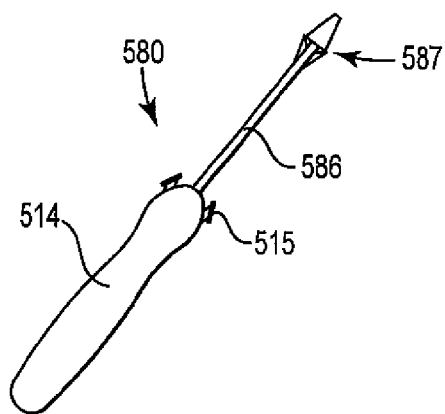


Fig. 31

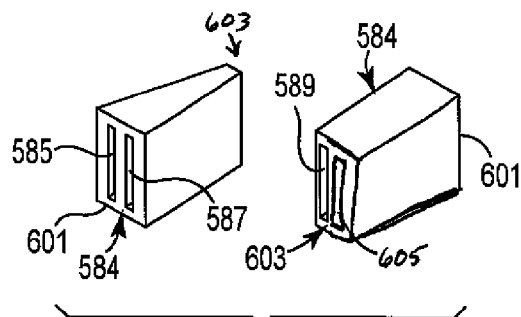


Fig. 32B

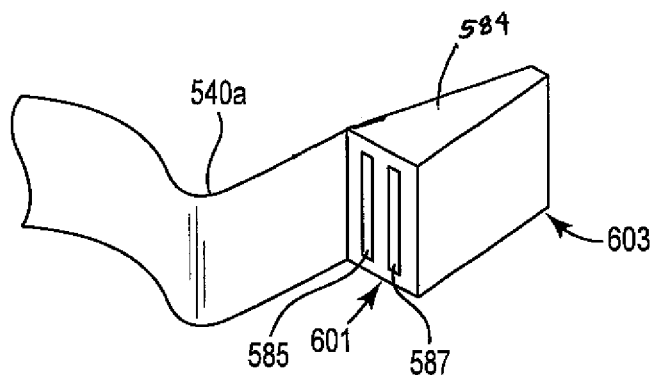


Fig. 33

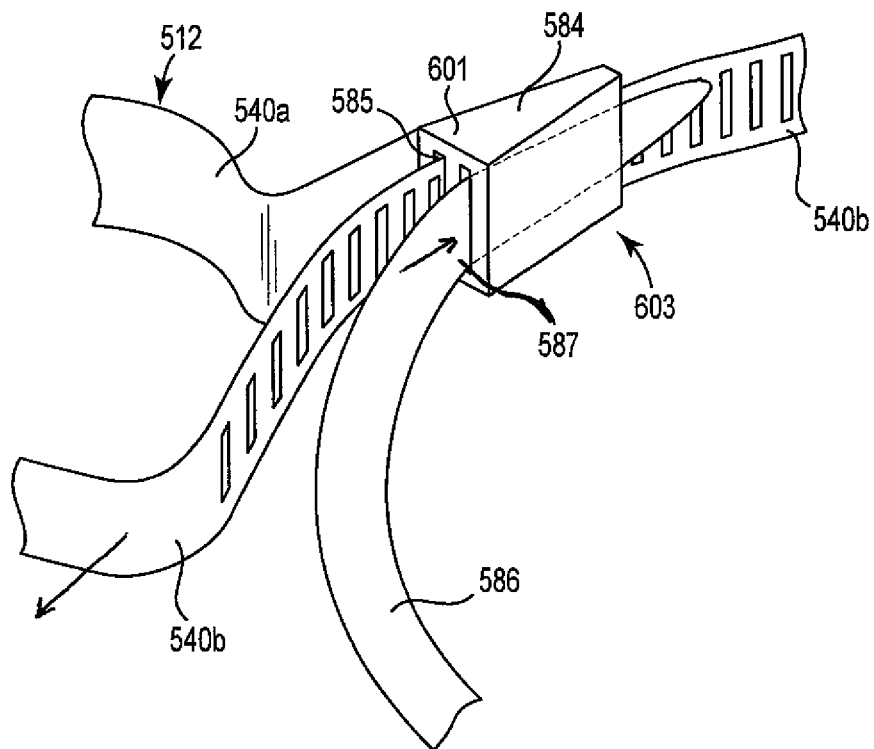


Fig. 34

SURGICAL ARTICLES AND METHODS

PRIORITY CLAIM

The present patent Application is a continuation-in-part (CIP) of International Application Number PCT/US2011/025917, filed Feb. 23, 2011, which in turn claims priority under 35 USC §119(e) to provisional application Ser. No. 61/307,264, filed Feb. 23, 2010, by Wirbisky et al., titled "Single Incision Sling and Method Therefor." The present patent application also claims priority to provisional application Ser. No. 61/423,851, filed Dec. 16, 2010, by Wirbisky et al., titled "Incontinence Sling and Delivery Systems and Methods," and provisional application Ser. No. 61/425,386, filed Dec. 21, 2010, by Wirbisky et al., titled "Implantable Slings for the Treatment of Male Urinary Incontinence," each of these applications being incorporated herein by reference in their entireties.

FIELD OF THE INVENTION

The invention relates to apparatus and methods for treating urinary incontinence by use of an implant to support urethral tissue.

BACKGROUND

Men, women, and children of all ages can suffer from urinary incontinence or involuntary loss of urinary control. Their lives are perpetually interrupted by thoughts of ensuring that they have ready access to a restroom. Everyday activities such as attending a theater or sporting event can become unpleasant. Sufferers often begin to avoid social situations in an effort to reduce the stress associated with their condition.

A variety of treatment options are currently available. Some of these include external devices, behavioral therapy (such as biofeedback, electrical stimulation, or Kegel exercises), prosthetic devices, and surgery. Depending on the age, medical condition, and personal preference of a patient, surgical procedures can be used to completely restore continence.

One type of surgical procedure found to be an especially successful treatment option for incontinence in both men and women is a sling procedure. Sling procedures typically entail surgically implanting a biocompatible implant or "sling" to support the bladder neck or urethra. Sling procedures are discussed in U.S. Pat. Nos. 5,112,344; 5,611,515; 5,842,478; 5,860,425; 5,899,909; 6,039,686; 6,042,534; 6,110,101; 6,478,727; 6,638,211; and PCT Publication Nos. WO 02/39890 and WO 02/069781.

Some "pubomedial" sling procedures involve an abdominal incision and installation of a sling between the rectus fascia in the abdominal region to a position below the urethra, and back again to the rectus fascia. A conventional procedure in females is to surgically place a sling by entering the abdominal cavity through an incision in the patient's pubovaginal region.

In males, one example of a conventional method involves surgical placement of a sling by entering the abdominal cavity through an abdominal incision. Unfortunately, to access the abdominal cavity a surgeon must incise the male patient's abdominal muscles. This procedure is more time consuming and uncomfortable for the male patient.

Other methods for treating pelvic conditions involve installation of a sling below the urethra through incisions made at the inner thigh (e.g., in the perineal skin facing the

obturator and in the groin), and using a tissue path extending through the obturator. These procedures can be referred to as "transobturator" methods. See, e.g., U.S. Pat. No. 6,911,003 and Published U.S. Pat. Appl. No. 2003/0171644A1, the entireties of each being incorporated herein by reference.

While abdominal and transobturator methods of treating urinary incontinence can be effective, safe, and long-lasting, there is ongoing effort toward improving these methods.

SUMMARY

The invention relates to methods of treating pelvic conditions, e.g., urinary incontinence, in males and females, and related implants and devices for placing the implants.

Certain embodiments of methods and implants involve placement of a tissue support portion of an implant below a urethra, preferably with placement of extension portions of the implant at tissue paths that extend from a location to support the urethra in a direction toward an obturator foramen. A tissue path may extend toward and end at pelvic fascia without reaching or passing into or through the obturator foramen. In other embodiments a tissue path may extend to the obturator foramen. In still other embodiments the tissue path may extend through an obturator foramen. The methods can involve two opposing tissue paths, as described, one on each of a left and a right side of the patient.

The implant may involve an adjustment feature that allows placement of the implant followed by or along with adjustment of the positioning or size of the implant, such as one or more adjustable extension portion. The adjustment feature may be a one-way adjusting engagement, a two-way adjusting engagement feature, a two-way adjusting feature that additionally includes a locking feature, etc. A method may involve adjusting the size of the implant by use of an adjusting feature or adjusting engagement between an extension portion and a support portion. The implant may be placed and optionally adjusted by use of a tool that can contact an implant to allow manipulation of the implant; optionally at the same time the tool may allow for or may be used to provide movement or approximation of tissue to be supported by the implant (e.g., tissue of a urethra).

In one aspect, the invention relates to a system for treating urinary incontinence, the system including a multi-piece implant comprising a support portion piece and an extension portion piece, and an adjusting tool. The support portion piece comprises a tissue support portion sized and shaped for placement to support a urethra. The extension portion piece comprises a proximal end, a distal end, and a tissue fastener, and is adjustably connected to the support portion piece at an adjusting engagement. The adjusting tool comprises a surface capable of engaging the support portion piece, and a moveable holder capable of holding the proximal end of the extension portion piece and moving the proximal end relative to the adjusting engagement.

In another aspect the invention relates to a system for treating a pelvic condition such as urinary incontinence, the system comprising an implant and a tool. The implant comprising a support portion, two extension portions, and two self-fixating tips, one self-fixating tip at an end of each extension portion, and a guide engaged with at least one of the self-fixating tips. The tool includes a shaft having a distal end capable of engaging the self-fixating tip, and a release mechanism at the distal end, the release mechanism capable of selectively engaging and releasing the self-fixating tip. The shaft is capable of engaging the guide to allow the shaft to be led along the guide to become engaged with the self-fixating tip.

In another aspect the invention relates to a system for treating a pelvic condition incontinence. The system includes an adjustable implant comprising a support portion, two extension portions, and two self-fixating tips. One self-fixating tip is located at an end of each extension portion. At least one self-fixating tip is moveably engaged with one of the two extension portions. The support portion being is movable to adjust a location of the support portion along the implant between the self-fixating tips.

In another aspect the invention relates to a system for treating urinary incontinence, the system comprising a multi-piece implant comprising a support portion piece and two extension portion pieces, and an adjusting tool. The support portion piece comprises a tissue support portion sized and shaped for placement to support a urethra. The extension portion pieces each comprise a proximal end, a distal end, and a tissue fastener. The first extension portion piece is adjustably connected to the support portion piece at a first adjusting engagement. The second extension portion piece is adjustably connected to the support portion piece at a second adjusting engagement. The adjusting tool comprises two adjusting surfaces, the two adjusting surfaces being capable of engaging the support portion piece in a manner to place tension along a length of the support portion piece.

In yet another aspect the invention relates to a system for treating urinary incontinence, the system comprising an implant and a tool. The implant comprises a support portion, two extension portions, and a self-fixating tip at a distal end of each extension portion. The tool comprises a proximal end and a distal end, a surface at the distal end capable of approximating a urethra, two shafts that can be extended and retracted from the distal end, and an adjusting surface at each shaft distal end, each adjusting surface being capable of engaging a self-fixating tip.

In another aspect the invention relates to a system for treating urinary incontinence, the system comprising a multi-piece implant comprising a support portion piece and an extension portion piece, and an adjusting tool. The support portion piece comprises a tissue support portion sized and shaped for placement to support a urethra. The extension portion piece comprises a proximal end, a distal end, and a tissue fastener, and is adjustably connected to the support portion piece at an adjusting engagement. The adjusting tool comprises a surface capable of engaging the support portion piece.

In another aspect the invention relates to a method of treating urinary incontinence in a male or a female patient. The method includes providing a system according as described herein, placing the implant below a urethra of the patient, and placing tissue fasteners at supportive tissue. Optionally the placement of the implant can be adjusted, the size of the implant or an extension portion can be adjusted, and the method can include using a tool to approximate tissue of the urethra.

In another aspect the invention relates to an implant for treating urinary incontinence. The implant includes: a support portion piece comprising a proximal end, a distal end, an extension portion, a tissue support portion, and a self-fixating tip at the distal end; an extension portion piece comprising a proximal end, a distal end, an extension portion and a self-fixating tip at the distal end; and an adjusting engagement that connects the extension portion piece with the support portion piece.

In yet another aspect the invention relates to a system useful to treat urinary incontinence. The system includes a multi-piece implant having a support portion piece and two

extension portions, and an adjusting tool. The support portion piece includes a tissue support portion sized and shaped for placement to support a urethra. The extension portions each comprise a proximal end, a distal end, and a self-fixating tip. The first extension portion is adjustably connected to the support portion piece at a first adjusting engagement. The second extension portion is adjustably connected to the support portion piece at a second adjusting engagement. And the adjusting tool comprises a force limiter.

BRIEF DESCRIPTION OF THE FIGURES

FIG. 1 illustrates an embodiment of a system as described, including a tool and an implant.

FIGS. 2A, 2B, and 2C illustrate an exemplary method useful with a described system.

FIG. 3 illustrates an embodiment of a system as described, including a tool and an implant.

FIGS. 4A, 4B, and 4C illustrate an exemplary method useful with a described system.

FIG. 5 illustrates an embodiment of a system as described, including a tool and an implant.

FIGS. 6A, 6B, and 6C illustrate an exemplary method useful with a described system.

FIG. 7 illustrates an embodiment of a system as described, including a tool and an implant.

FIGS. 8A, 8B, and 8C illustrate an exemplary method useful with a described system.

FIGS. 9A and 9B illustrate embodiments of systems as described, including a tool and an implant.

FIGS. 10A, 10B, and 10C illustrate an exemplary method useful with a described system.

FIG. 10D illustrates an embodiment of a system as described, including a tool and an implant.

FIG. 11 illustrates an embodiment of a system as described, including a tool and an implant.

FIGS. 12A, 12B, and 12C illustrate an exemplary method useful with a described system.

FIGS. 12D and 12E illustrate an exemplary tool useful with a described system.

FIG. 13 illustrates an embodiment of a system as described, including a tool and an implant.

FIGS. 14A, 14B, and 14C illustrate an exemplary method useful with a described system.

FIG. 15 illustrates an embodiment of a system as described, including a tool and an implant.

FIGS. 16A, 16B, and 16C illustrate an exemplary method useful with a described system.

FIGS. 17A, 17B, 17C, and 17D illustrate embodiments of systems as described, including tools and an implant.

FIG. 17E is a front view of an exemplary implant adjustment tool for use with implants, as shown and described.

FIG. 17F is a top view of the implant adjustment tool of FIG. 17E.

FIG. 17G is a front view of a portion of the implant adjustment tool of FIG. 17E, which includes an exemplary embodiment of a limiter.

FIGS. 18A, 18B, and 18C illustrate an exemplary method useful with a described system.

FIG. 19 illustrates an embodiment of a system as described, including a tool and an implant.

FIG. 20 illustrates an embodiment of a system as described, including a tool and an implant.

FIG. 21 illustrates an embodiment of a system as described, including a tool and an implant.

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FIG. 22 illustrates an embodiment of a system as described, including a tool and an implant.

FIG. 23 illustrates an embodiment of an implant as described.

FIG. 24 illustrates an embodiment of a system as described, including a tool and an implant.

FIG. 25 illustrates an embodiment of an implant as described.

FIGS. 26 through 29 illustrate an exemplary method useful with a described system.

FIG. 30 illustrates an embodiment of an implant as described.

FIG. 31 illustrates an embodiment of an implant as described.

FIGS. 32A and 32B illustrate an embodiment of an implant as described.

FIGS. 33 and 34 illustrate an embodiment of a system as described, including a tool and implant.

DETAILED DESCRIPTION

The systems, devices, tools, implants, etc., described herein are directed to surgical instruments, assemblies, implantable articles, systems and related methods for treating urinary incontinence in a male or female, including stress urinary incontinence (SUI). An implant can be implanted in a male or a female to treat a condition such as urge incontinence, mixed incontinence, overflow incontinence, functional incontinence, and the like.

An implant can include a tissue support portion (or “support portion”) that can be used to support a urethra or other pelvic tissue. Supporting a “urethra” refers to supporting tissue that includes the urethra (which can refer to the bladder neck) and that can optionally include tissue adjacent to a urethra such as bulbospongiosus muscle, corpus spongiosum, or both. According to various methods, for example, a support portion may either be placed below bulbospongiosus muscle to support both bulbospongiosus muscle and corpus spongiosum (along with the urethra), or alternately bulbospongiosus muscle may be dissected and a support portion may be placed to contact corpus spongiosum tissue (to support the urethra).

An implant can additionally include one or more extension portion (otherwise known as an “end” portion or “arm”) attached or attachable to the tissue support portion. Normally, for treating incontinence, an implant can include two opposing extension portions. Extension portions are elongate pieces of material (e.g., mesh, suture, or biologic material) that extend from the tissue support portion and either are or can be connected to the tissue support portion, and are useful to attach to anatomical features or “supportive tissue” in the pelvic region (e.g., using a self-fixating tip or another form of tissue fastener) to thereby provide support for the tissue support portion and the supported tissue. Generally for treating incontinence, two extension portions can extend from the opposite ends of a tissue support portion as elongate “ends,” “arms,” or “extensions,” and may attach to supportive tissue in the pelvic region by extending through a tissue path to an internal anchoring point (see, e.g., Applicant’s copending United States Patent Application Publication number US 2010/256442, filed Aug. 8, 2008, by Ogdahl, entitled SURGICAL ARTICLES AND METHODS FOR TREATING PELVIC CONDITIONS, the entirety of which is incorporated herein by reference), or may extend to an external incision, such as through an obturator foramen and through an external incision at a groin or inner thigh (see, e.g., Applicant’s copending United States Patent Pub-

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lication Number US 2006/0287571, the entirety of which is incorporated herein by reference). Also see U.S. Patent Publication number US 2011/0034759 and WO 2010/093421, the entireties of which are incorporated hereby by reference.

In exemplary uses, each extension portion can extend from the location of attachment with the tissue support portion, through pelvic tissue, and optionally be attached to supportive tissue within the pelvic region. For certain procedures the supportive tissue can be tissue adjacent to the urethra such as pelvic fascia; tissue between the urethra and an obturator foramen such as pelvic fascia; or tissue of an obturator foramen such as obturator fascia, obturator internus muscle, obturator membrane, obturator externus muscle, etc. For alternate procedures an extension portion can be sized to extend from the tissue support portion, through an obturator foramen, around a pubic ramus bone, and threaded (subcutaneously) back to a medial location such as near a medial incision.

An implant may include portions, pieces, or sections that are synthetic or of biologic material (e.g., porcine, cadaveric, etc.). Extension portions may be, e.g., a synthetic mesh such as a polypropylene mesh, a suture, a biodegradable suture, etc. The tissue support portion may be synthetic (e.g., a polypropylene mesh) or biologic. Examples of implant products that may be similar to those useful according to the present description, include those sold commercially by American Medical Systems, Inc., of Minnetonka Minn., under the trade names Apogee®, Perigee®, and Elevate® for use in treating pelvic prolapse (including vaginal vault prolapse, cystocele, enterocele, etc.), and Sparc®, Bioarc®, Monarc®, and MiniArc® for treating urinary incontinence.

An example of a particular type of pelvic implant is the type that includes supportive portions including or consisting of a tissue support portion and two opposing extension portions extending from the tissue support portion. An implant that has exactly two extension portions can be of the type useful for treating urinary incontinence. The term “supportive portions” refers to portions of an implant that function to support tissue after the implant has been implanted, and specifically includes extension portions and tissue support portions, and does not include optional or appurtenant features of an implant such as a sheath, tensioning suture, tissue fastener, or self-fixating tip or other type of connector for attaching the implant to an insertion tool.

A preferred implant (e.g., sling) for placement against a corpus spongiosum for treatment of urinary incontinence in a male patient may optionally and preferably include a widened central support to provide increased contact and frictional engagement with the corpus spongiosum. See, for example, Assignee’s copending United States Patent Publication Number US 2006/0287571 and U.S. Pat. No. 7,422, 557, the entireties of these applications being incorporated herein by reference.

Dimensions of a tissue support portion can be any dimensions useful to support urethra tissue for treating incontinence. A tissue support portion can be of sufficient length to support and optionally partially surround a urethra or urethra-supporting tissue. A width of a tissue support portion may optionally and preferably be greater than a width of extension portions and can be sufficiently wide to increase contact area and frictional forces between a tissue support portion and a tissue in contact with the tissue support portion. Exemplary lengths of a tissue support portion can be in the range from 0.5 to 2 inches, such as from 0.75 to 1.5 inches. Exemplary widths of a tissue support portion can be

in the range from 0.4 or 0.5 to 4 centimeters, such as from 1 to 2.5 or 3 centimeters. (A tissue support portion may be part of a support portion piece that includes the tissue support portion and optionally some amount of opposing extension portions extending from ends of the tissue support portion.

Dimensions of extension portions according to the invention can allow the extension portion to reach between a tissue support portion placed to support a urethra (at an end of the extension portion connected to the tissue support portion) and a location at which the distal end of the extension portion attaches to supportive tissue at or about the pelvic region. Exemplary lengths of an extension portion for these embodiments, measured for example between a connection or boundary between the extension portion and the tissue support portion, and a distal end of the extension portion, can be, e.g., from 0.5 to 2.75 inches, preferably from 1.0 to 2.25 inches, and the length can optionally and preferably be adjustable. As described elsewhere herein, a length of an extension portion may be fixed (i.e., the extension portion does not include any form of length-adjusting mechanism). Alternate embodiments of implants may include an adjusting engagement that allows a physician to alter the length of an extension portion before, during, or after implantation.

Implants as described can include a tissue fastener at a distal end or a distal portion of an extension portion, which is the end or portion not attached to a tissue support portion. (The term “distal” as used herein (unless noted otherwise) generally refers to a direction toward a patient and away from a surgeon installing a device.) A tissue fastener at a distal end or portion of an extension portion can be any of various types, including: a self-fixating tip that is inserted into soft tissue and frictionally retained; soft tissue anchors; biologic adhesive; a soft tissue clamp that can generally include opposing, optionally biased, jaws that close to grab tissue; and opposing male and female connector elements that engage to secure an end of an extension portion to tissue. (See International Patent Application No. PCT/US2007/014120, entitled “Surgical Implants, Tools, and Methods for Treating Pelvic Conditions, filed Jun. 15, 2007; U.S. patent application Ser. No. 12/223,846, filed Aug. 8, 2008, entitled SURGICAL ARTICLES AND METHODS FOR TREATING PELVIC CONDITIONS; U.S. patent application Ser. No. 12/669,099, filed Jan. 14, 2010, entitled PELVIC FLOOR TREATMENTS AND RELATED TOOLS AND IMPLANTS; and WO 2009/075800, the entireties of which are incorporated herein by reference.) An implant may also have one or more extension portion that does not include a tissue fastener, for example if the distal end is designed to be secured to tissue by other methods (e.g., suturing), or is intended to pass through an obturator foramen and a tissue path around a pubic ramus bone, in which case the extension portion may optionally include a connector, dilator, or dilating connector, which connects to an elongate tool that can be used to either push or pull the connector, dilator, or dilating connector through a tissue path (e.g., to a medial incision).

One embodiment of a tissue fastener is a self-fixating tip. A “self-fixating tip” in general can be a structure (sometimes referred to as a soft tissue anchor) connected at a distal end of an extension portion (or extension portion piece) that can be implanted into soft tissue (e.g., muscle, fascia, ligament, etc.) in a manner that will maintain the position of the self-fixating tip and support the attached implant. Exemplary self-fixating tips can also be designed to engage an end of an insertion tool (e.g., elongate needle, elongate tube, etc.) so

the insertion tool can be used to push the self-fixating tip through and into tissue for implantation, preferably also through a medial incision to reach the interior of the pelvic region, e.g., at a location of an obturator foramen. The insertion tool may engage the self-fixating tip at an internal channel of the self-fixating tip, at an external location such as at an external surface of the base, at a lateral extension, or otherwise as desired, optionally in a manner to allow the insertion tool to push the self-fixating tip through an incision in a patient and through and into supportive tissue.

Exemplary self-fixating tips can include one or more lateral extensions that allow the self-fixating tip to be inserted into soft tissue and to become effectively anchored in the tissue. A lateral extension may be moveable or fixed. The size of the self-fixating tip and optional lateral extensions can be useful to penetrate and become anchored into the tissue. Exemplary self-fixating tips are described in Assignee’s copending international patent application PCTUS2007/004015, filed Feb. 16, 2007, titled Surgical Articles and Methods for Treating Pelvic Conditions, the entirety of which is incorporated herein by reference. Other structures may also be useful.

According to exemplary embodiments, a self-fixating tip can have structure that includes a base having a proximal base end and a distal base end. The proximal base end can be connected (directly or indirectly, such as by a connective suture) to a distal end of an extension portion. The base extends from the proximal base end to the distal base end and can optionally include an internal channel extending from the proximal base end at least partially along a length of the base toward the distal base end. The optional internal channel can be designed to interact with (i.e., engage, optionally by means of a release mechanism that can be selectively engaged and released) a distal end of an insertion tool to allow the insertion tool to be used to place the self-fixating tip at a location within pelvic tissue of the patient. A self-fixating tip can be made out of any useful material, generally including materials that can be molded or formed to a desired structure and connected to or attached to a distal end of an extension portion of an implant. Useful materials can include plastics such as polyethylene, polypropylene, and other thermoplastic or thermoformable materials, as well as metals, ceramics, and other types of biocompatible and optionally bioabsorbable or bioresorbable materials. Exemplary bioabsorbable materials include, e.g., polyglycolic acid (PGA), polylactide (PLA), copolymers of PGA and PLA.

According to various systems as described, one or more instrument, insertion tool, adjusting tool, or the like, may be incorporated or used with the described implants and methods. Examples of useful tools include those that generally include one or more (stationary or moveable) thin elongate, relatively rigid shaft or needle that extends from a handle. The shaft can be a single elongate shaft or multiple separate elongate shafts extending from the handle, or one or more primary shaft that extends from the handle and that contains multiple branch or “tine” shafts that separate at the end of the primary shaft. The handle is located at a proximal end of the device and attaches to one end (a proximal end) of a shaft. According to some embodiments, a distal end of one or more shaft can be adapted to engage a portion of an implant, such as a tissue fastener (e.g., a self-fixating tip), in a manner that allows the insertion tool to engage and push the tissue fastener through a tissue passage and connect the tissue fastener to supportive tissue of the pelvic region. Examples of this type of tool can be used with a self-fixating tip that includes an internal channel designed to be engaged

by a distal end of an insertion tool to allow the self-fixating tip to be pushed into tissue. Other general types of insertion tools will also be useful, but may engage a self-fixating tip or other tissue fastener in an alternate manner, e.g., that does not involve an internal channel.

According to other embodiments, a distal end of a tool (e.g., at one more shaft) can be adapted to engage one or more other portion of an implant, such as support portion, a proximal end of an extension portion, or both. The insertion tool may manipulate a tissue support portion and an extension portion of a multi-piece implant in a manner to allow the tool to adjust the size or positioning of the implant.

Exemplary insertion tools for treatment of incontinence and vaginal prolapse are described, e.g., in U.S. patent application Ser. Nos. 10/834,943, 10/306,179; 11/347,553; 11/398,368; 10/840,646; PCT application number 2006/028828; PCT application number 2006/0260618; WO 2010/093421, and US Patent Publication No. 2010-0256442 the entirety of these documents being incorporated herein by reference.

A tool according to the invention can optionally include a mechanism by which a tissue fastener (e.g., a self-fixating tip) can be securely and releasably engaged with a distal end of an insertion tool such that the tissue fastener can be selectively secured to the distal end mechanically, then selectively released. With a releasable engagement, a tissue fastener (e.g., self-fixating tip) can be released from the distal end by releasing the engagement (e.g., mechanical engagement) by movement of an actuator at the proximal end of the insertion tool, such as at the handle. For example, an internal channel (or external surface) of a self-fixating tip can include an engaging surface designed to engage a mechanism at a distal end of an insertion tool while the self-fixating tip is placed at, on, or over the distal end. As an example, an internal or external surface of a self-fixating tip can include a depression, ring, edge, or ledge, that can be rounded, angular, etc. A mechanical detent such as a pin, ball, spring, deflector, or other surface or extension located at the distal end of the insertion tool can be moved, deflected, or extended relative to the distal end of the insertion tool to contact the surface of the self-fixating tip to securely and releasably hold the self-fixating tip at the distal end of the insertion tool and prevent removal of the tip from the distal end until removal is desired. The detent (or other surface or mechanism) can be caused to extend (or retract) from the distal end of the insertion tool by actuating a trigger or other mechanism located at the proximal end (e.g., handle or a proximal location of a shaft) of the insertion tool, to secure (or release) the self-fixating tip. Upon placement of the self-fixating tip at a desired location during a surgical implantation procedure, the insertion tool operator can release the self-fixating tip by use of the trigger or other mechanism at the handle to disengage the detent and cause the tip to become loose. The insertion tool can then be removed from the tissue path, and the self-fixating tip can remain in a desired implanted location.

Optionally, an implant can include a tissue fastener at a location of a tissue support portion, or at a location along a length of an extension portion. This form of tissue fastener can be in the form of reinforced (e.g., by coating, heat treating, or a reinforcing weave or strip) edge extensions, multiple layers of mesh and edge extensions in an extension portion, etc., as described, for example, at Applicant's copending U.S. Pat. No. 7,422,557, and Applicant's copending United States Patent Publication Numbers US 2006/0195011, US 2006/0195007, and US 2006/0195010, all of which are incorporated herein by reference. Other examples

include relatively rigid structures such as metal, plastic, or other polymeric or non-polymeric structure that may be shaped to frictionally engage soft tissue, for example to include a tine, hook, chevron, barb, arrow, etc., combinations thereof, or any structure added to an edge or surface of an extension portion to improve fixation within tissue. The structure can have any shape or form that will increase frictional force between the implant and adjacent tissue, such as one or multiple pointed surface directed along a length of an extension portion, toward the tissue support portion, and extending away from a surface or edge of the implant (e.g., extension portion). The tissue fastener can be located at a position of an implant that will result in the tissue fastener being located at supportive tissue such as muscle or fascia when the implant is placed with a midline of the tissue support portion being located below a urethra. For example, a tissue fastener may be located on a tissue support portion or an extension portion of an implant, e.g., as close as 2 or 3 centimeters from a midline of a tissue support portion, and up to a distance that reaches tissue of an obturator foramen when the midline is located below a urethra, e.g., up to 7 centimeter from the midline.

According to various embodiments of implants described herein, an implant can include multiple pieces that are adjustably connected together by an adjusting engagement. A "multi-piece" implant refers to an implant that includes a "support portion piece" and one or multiple "extension portion piece" as separate pieces of the implant. An extension portion piece can be separate from a support portion piece, and the two pieces can be connected through an adjustable engagement. The support portion piece includes a tissue support portion.

An adjusting engagement may be for example a one-way adjusting engagement, a two-way adjusting engagement, or a locking two-way engagement, that allows a portion, piece, or a segment of an implant to be moved relative to another portion, piece, or segment if the implant and adjusted as to length, tension, or positioning. Examples of adjusting engagements are described, for example, in Applicant's copending U.S. patent application Ser. No. 12/308,436, filed Dec. 15, 2008, entitled SURGICAL IMPLANTS AND TOOLS FOR TREATING PELVIC CONDITIONS, and U.S. patent application Ser. No. 12/669,099, filed Jan. 14, 2010, entitled PELVIC FLOOR TREATMENTS AND RELATED TOOLS AND IMPLANTS, the entireties of which are incorporated herein by reference.

Some adjusting engagements can allow two-way movement of one piece relative to another piece (e.g., a "two-way" adjusting engagement). This type of adjusting engagement allows movement of a segment of implant (e.g., of a segment or portion of an extension portion piece) in two directions through an adjusting engagement. The force needed to move the segment of implant in one direction is substantially equal to the force needed to move the segment in the opposite direction, and, optionally, the two-way adjusting engagement does not substantially hinder the movement of a segment of implant through the adjusting engagement with frictional surfaces such as extensions (e.g., "teeth") extending into an aperture through which the segment of implant is moved. As an example, a two-way adjusting engagement may include an open (smooth) aperture that may be circular, oval, square, elongate, or rectangular, such as in the form of a circle, slit, or slot, etc. The aperture may optionally be reinforced by a reinforced perimeter of a shape that is similar to the aperture, such as by a fabric or a polymeric material such as a grommet (e.g., a "loose grommet" or "eyelet"), which may be circular,

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square, rectangular, or of any desired shape. The reinforced perimeter (e.g., grommet) defines a reinforced aperture through which a segment of implant can pass relatively freely and with the same resistance two different directions.

A two-way adjusting engagement may optionally be capable of an open and a closed (e.g., locked) configuration, the open configuration allowing two-way movement between the pieces, and the closed (or locked) configuration preventing any movement between the pieces. Such an adjusting engagement may be referred to as a locking two-way adjusting engagement, and may include any form of mechanical securement device that can be configured in an open configuration (to allow two-way movement between pieces) and a closed configuration (to prevent movement between pieces). The locking two-way adjusting engagement may be selectively and reversibly moveable between the open configuration and the closed configuration, or may instead initially be an open configuration that, once placed in a closed configuration, cannot be re-configured to the open configuration. Examples of structures that may be part of a locking two-way adjusting engagement include a mechanical clip, staple, stitch, detent, or rivet; any form of spring-loaded or moveable frictional engagement; a non-moveable frictional engagement such as a slot, slit, cleat, or other non-moveable aperture or opening through which a portion of implant can be selectively engaged, released, and re-engaged; a deformable opening, ring, clip, staple, etc., which may be generally open and then permanently closed by mechanical deformation; and the like. One form of exemplary structure may be forceably closed (e.g. by bending a part until permanent deformation or closing a part until some latch or similar feature snaps shut), while others may be biased to close (e.g. a spring-loaded clip is held open until released so it can clamp shut). Changing from an open to a closed orientation could be performed by an independent tool, or may be an additional feature built into the adjustment tool. The clip or alternate opening-closing structure could be attached to larger structure of an adjusting engagement (potentially integrated into its design), or separate (so it could be loaded into the tool).

Other adjusting engagements may allow for one-way adjustment such as shortening of a length of an extension portion. These adjusting engagements can be referred to as "one-way" adjusting engagements, and allow adjustment of a length of an implant portion (e.g., extension portion) in one direction and not (or not easily) in an opposite direction. An exemplary one-way adjusting engagement can include an aperture through which a segment of implant (e.g., a portion of an extension portion piece) can extend, and one or multiple surfaces (e.g., extensions or teeth) that frictionally engage the segment of implant passing therethrough, e.g., by extending into or toward the aperture or otherwise contacting the segment of implant to inhibit movement of the segment of implant relative to the adjusting engagement. The one-way engagement can preferentially allow movement of the segment of implant through the aperture in one direction while inhibiting or preventing movement of the segment of implant in an opposing direction.

In use of a tissue support portion that includes a one-way adjusting engagement such as a round or rectangular grommet, a tissue fastener (e.g., a self-fixating tip) at one end of an extension portion is placed at tissue as desired, and the second (loose) end of the extension portion piece is passed through the one-way adjusting engagement. The engagement is adjusted to place the support portion piece at a desired position (length) of the extension portion piece to provide desired support to a urethra. The one-way adjusting

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engagement moves easily along the extension portion piece in a direction that tightens the implant against urethra tissue, and does not move easily in the opposite direction. Once placed in position below the urethra and tightened as desired, the support portion piece is prevented from moving along the extension portion piece in the direction to reduce support of the urethra. The extension portion piece may optionally be considered to be "smooth," without any visible frictional surface, or may alternately include bumps, detents, teeth, a jagged surface, or other frictional or mechanical structure to engage opposing structure at a surface of an aperture of the one-way adjusting engagement.

FIG. 1 illustrates a system that includes implant 22 (e.g., for treating male or female urinary incontinence) and insertion tool 10. Implant 22 includes support portion 24, end or extension portions 26, and self-fixating tips 28. Guide collars 30 are engaged with each of self-fixating tips 28. Insertion tool 10 includes shaft 12, distal end 14, proximal end and handle 20, release mechanism (e.g., comprising detents, teeth, or extensions) 16, and trigger 18 located at a proximal region of shaft 12. Trigger 18 can activate and de-activate release mechanism 16 to selectively securely engage and release self-fixating tip 28, relative to distal end 14.

FIG. 1 additionally shows a feature of two guides (e.g., guide tubes) 30, each guide being removably engaged with one of the two self-fixating tips 28. Each guide 30 allows a user to move a distal end of shaft of an insertion tool (e.g., 10) into engagement with a self-fixating tip (e.g., 28). In specific, guide 30 is in the form of a hollow guide tube, having an elongate hollow shaft and two ends, one opening at each end. A distal end opening engages a channel or bore of self-fixating tip 28. The distal end removably engages self-fixating tip 28 through any removable or disengageable structure, such as a threaded engagement, a perforated engagement, a frictional engagement, or any other form of engagement that can be broken, disrupted, or disengaged by a separate mechanical mechanism located on tool 10, e.g., between proximal handle 20 and distal end 14.

During use, a distal end of an insertion tool (e.g., distal end 14) can be inserted into a proximal end of a guide tube and guided through the guide tube to engage self-fixating tip 28. The guide allows the distal end to engage the self-fixating tip while the self-fixating tip is engaged with the guide. This allows the distal end to engage the self-fixating tip outside of the patient so a surgeon can use the insertion tool to initially place the self-fixating tip through a medial incision and into engagement with supportive tissue. The initial placement may first be performed, after which the shaft and distal end may be removed from the guide and the patient, and the placement and tension of the self-fixating tip and implant may be tested to determine if adjustment is necessary. If so, the distal end and shaft may be re-engaged with the self-fixating tip previously placed at the tissue by re-inserting the distal end into the guide (which is accessible, e.g., a proximal end can remain outside of the patient) and passing the distal end through the guide to re-engage the distal end with the self-fixating tip. The guide leads the distal end to the self-fixating tip, and the distal end can re-engage the self-fixating tip. The insertion tool can then be used to push the self-fixating tip to a location of deeper penetration into the tissue.

After desired placement of the self-fixating tip, followed by disengagement and optional re-engagement of an insertion tool with the initially-placed self-fixating tip, and adjustment, the insertion tool can be removed from the guide

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and the guide can be removed from the self-fixating tip (optionally while the distal end is engaged with the self-fixating tip).

FIGS. 2A, 2B, and 2C, illustrate a method of using tool 10 to place implant 22, with guides 30, to treat urinary incontinence. Patient anatomy includes a medial (e.g., perineal) incision (not shown), a location of a urethra (not shown) and corpus spongiosum 32, corpus cavernosa 36 and pubic ramus bones 34, which bound an obturator foramen (not shown). A distal end of insertion tool 10, passed through guide tube 30 and engaged with self-fixating tip 28, is used to insert self-fixating tip 28 through a medial (e.g., perineal or vaginal) incision and place self-fixating tip 28 at supportive tissue in a region of an obturator foramen on a first side of the patient. See FIG. 2A. Insertion tool 10 is then withdrawn from self-fixating tip 28 and guide tube 30. Release mechanism 16 (e.g., detents) at distal end 14 can be selectively engaged and released as desired. For example, self-fixating tip 28 can be placed in supportive tissue with release mechanism activated to secure tip 28 at distal end 14, and can be de-activated to disengage distal end 14 from self-fixating tip 28 after placement of the tip, followed by withdrawal of shaft 12 away from self-fixating tip 28 and back out of guide tube 30.

As then shown at FIG. 2B, tool 10 can be used to engage the second self-fixating tip 28 of implant 22, through second guide tube 30, and the second self-fixating tip 28 can be placed at supportive tissue in a region of an obturator foramen on a second side of the patient. Tool 10 can optionally be disengaged (by use of trigger 18) from self-fixating tip 28 and withdrawn from guide tube 30.

Optionally tool 10 may be used to adjust the position (e.g., depth) of one or both of self-fixating tips 28 within supportive tissue by re-engaging one or both of self-fixating tips (28) through guide 30 to then push a self-fixating tip 28 to a deeper location within the supportive tissue. The opening at the distal end of each guide tube can be accessible, e.g., extends to a location outside of the patient, while the proximal end of the guide tube and the attached self-fixating tip (28) are located within the supportive tissue (e.g., at a region of an obturator foramen). Upon final adjustment, each of guide tubes 30 can be removed from self-fixating tips 28 and the patient. Removal of a guide tube 30 can optionally be performed with assistance of insertion tool 10. For example, to remove a guide tube 30 from a self-fixating tip, tool 10 can be re-inserted into the guide tube and re-engaged with the self-fixating tip. The tool can engage the self-fixating tip to hold the tip at its location within supportive tissue and prevent undesired (proximal) forces from being applied to the properly-placed self-fixating tip while pressure is placed on the guide tube to separate the guide tube from the self-fixating tip.

FIG. 3 illustrates a system that includes implant 52 (e.g., for treating male or female urinary incontinence) and insertion tool 50. Implant 52 includes support portion 54, two opposing end or extension portions 56, and self-fixating tips 58. Support portion 54 is moveable along the length of the implant between self-fixating tips 58. One of the self-fixating tips includes a tightening buckle 60 through which extension portion 56 can be threaded and frictionally engaged. Tightening buckle 60 includes two frictional surfaces, one hinged frictional surface 64 and a second non-hinged frictional surface 62. As illustrated, frictional surface 62 is stationary and frictional surface 64 is hinged to form a frictional engagement that allows for loose end 51 of implant 52 to be pulled (proximally) away from buckle 60, after which, buckle 60 inhibits movement in an opposite direction. In

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use, a length of extension portion 56 can be threaded initially through hinged loop 68 and stationary loop 66 (see inset at FIG. 3, lower image), adjacent to hinged surface 64 and stationary surface 62, respectively. Extension portion 56 is then threaded back and over stationary frictional surface 62 (outside of loop 66), past hinged frictional surface 64 and through hinged loop 68, to contact the portion of extension portion 56 entering hinged loop 68, then back in a proximal direction (now referred to as loose end 51). Loose end 51 can be pulled to shorten the length of implant located between the two self-fixating tips 58 and to produce a taught length of implant supporting a urethra, after which buckle 60 inhibits loosening or lengthening of the implant within the patient.

Tool 50 includes handle 40, shaft 42, and distal end 44 capable of engaging an aperture of each of self-fixating tips 88. Tool 50 is not specifically illustrated to include a release mechanism like that described with respect to tool 10, but tool 50 could optionally include a release mechanism.

FIGS. 4A, 4B, and 4C, illustrate a method of using tool 50 to place implant 52, having tightening buckle 60 at one end of an extension portion, and adjustable support portion location, to treat urinary incontinence. Patient anatomy is as described previously. A distal end of insertion tool 50, engaged with self-fixating tip 58, is used to insert self-fixating tip 58 through a medial incision and place self-fixating tip 58 at supportive tissue in a region of an obturator foramen on a first side of the patient. See FIG. 4A. Insertion tool 50 is then used to engage the second self-fixating tip 58 for placement of the second self-fixating tip 58 at supportive tissue in a region of an obturator foramen on a second side of the patient. Loose end 51 can be accessible (e.g., can extend out of the medial incision) and can be pulled (proximally) to adjust a length of implant between self-fixating tips 58, to provide desired tension on the length of implant, and desired approximation, placement, and support of the urethra. See FIG. 4B. Loose end 51 can then be removed by cutting. See FIG. 4C. Before, after, or simultaneously with tightening the length of implant by pulling loose end 51, moveable support portion 54 can be moved (slid) in a direction toward one or the other obturator foramen to place moveable support portion 54 at a desired (central, medial) location below the urethra.

FIG. 5 illustrates a system that includes implant 78 (e.g., for treating male or female urinary incontinence) and insertion tool 80. Implant 78 includes support portion 84, end or extension portions 86, and self-fixating tips 88. Support portion 84 is moveable along the length of the implant between self-fixating tips 88. Extension portions 86 extend through supports (or guides, having apertures) 85 located on support portion 84, allowing each support (or guide) 85 of support portion 84 to be moved and positioned at a desired location along a length of each extension portion 86. The effect is to allow a user to reduce or increase (i.e., lengthen) the effective size of each extension portion by sliding each support 85 toward a respective self-fixating tip 88, on one or both sides of the implant and patient, thereby reducing the overall length of implant 78 between self-fixating tips 88. Support (guide) 85 supports extension portion 86 by means of a one-way or a two-way adjusting engagement.

Upon desired adjustment, locking disk 92 can be moved distally (toward the patient and toward support portion 84 and self-fixating tips 88) along proximal portions (or loop) 76 of extension portions 86, to secure the location of support portion 84 relative to extension portions 86. Locking disk 92 can be frictionally secured to proximal portions 76 to prevent movement of support portion 84 relative to exten-

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sion portions **86** after desired placement of locking disk **92** relative to proximal portions **76**. Optionally an adjusting tool **90** (or “disk pusher tool” **90**) can be used to push disk **92** along lengths of proximal portions **76** and toward support portion **84**. Proximal portions **76** can be threaded through aperture **96** at a distal end of tool **90**, and distal surface **94**, which surrounds aperture **96**, can contact a proximal surface of disk **92** to push disk **92** distally along proximal portions **76** and toward support portion **84**.

Tool **80** includes handle **81**, shaft **83**, and distal end **89** capable of engaging an aperture of each of self-fixating tips **88**. Tool **80** is not illustrated to include a release mechanism like that described with respect to tool **10**, but tool **80** could optionally include a release mechanism.

FIGS. **6A**, **6B**, and **6C**, illustrate a method of using tools **80** and **90** to place implant **78**, having adjustable support portion **84** and adjustable-length extension portions **86**, to treat urinary incontinence. Patient anatomy is as described previously. Distal end **89** of insertion tool **80**, engaged with self-fixating tip **88**, is used to insert self-fixating tip **88** through a medial incision and place self-fixating tip **88** at supportive tissue in a region of an obturator foramen on a first side of the patient. See FIG. **6A**. Insertion tool **80** is then used to engage the second self-fixating tip **88**, and the second self-fixating tip **88** can be placed at supportive tissue in a region of an obturator foramen on a second side of the patient. Proximal portions **76** can be pulled or tensioned (optionally with insertion tool **80** engaged with a self-fixating tip **88**, to prevent force being placed on the self-fixating tip) while adjustable support portion **84** is advanced distally toward the patient to adjust a lengths of extension portions **86** and the length implant between self-fixating tips **88**, and to provide desired tension on the length of implant and desired approximation, placement, and support of the urethra. See FIG. **6B**. Locking disk **92** (a one-way adjusting engagement relative) can be moved (e.g., slid) distally toward the patient to frictionally engage proximal portions **76** to maintain the position of adjustable support portion **84** relative to extension portions **86** and the urethra. Disk pusher tool **90** can be used to move locking disk **92**. Proximal portions **76** can be removed by cutting. See FIG. **6C**.

Embodiments of systems, kits, methods, and devices as described also include adjusting tools for simultaneously contacting two surfaces of an implant, especially two spaced surfaces of a support portion piece, e.g., to manipulate or stabilize the support portion piece, to allow adjustment of extension portion pieces relative to the support portion piece. Preferred tools can include two adjusting surfaces that are capable of concurrently (e.g., simultaneously) contacting two spaced surfaces of a support portion piece, each of the two surfaces of the support portion piece being part of, at, or adjacent to a component of an adjusting engagement, e.g., a one-way adjusting engagement or a two-way adjusting engagement that can be closed or locked.

An adjusting tool can include any useful structure to support the adjusting surfaces of the adjusting tool, such as a handle (optional) at a proximal end, a shaft or multiple shafts extending from the handle, or alternate forms of support for the adjusting surfaces. An adjusting surface can be any surface that can contact or otherwise engage a surface of an implant or a component of an implant. Optionally an adjusting surface can be a structure that defines an aperture, slot, opening, channel, peg, slit, extension, insert, or other surface that is sized to engage a opposing or complementary component or surface of a single piece or a multi piece implant, e.g., an extension portion piece (e.g., a proximal end of an extension portion piece), a support portion piece,

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or a tissue fastener (e.g., a self-fixating tip). Adjusting surfaces of an adjusting tool can be spaced from each other by a distance that will allow simultaneous contact with two locations on opposing sides of an implant during use of the adjusting tool to position and optionally adjust the position of the implant relative to urethral tissue being supported. For example, adjusting surfaces may be located on a line that is perpendicular to an axis of a shaft of an adjusting tool, or that is perpendicular to a line parallel to an axis of a shaft of a tool, and may be spaced by a distance in the range of 0.5 to 10 centimeters, such as a distance in the range from 2 to 8 centimeters or from 2 to 6 centimeters (depending on the locations of the implant that the adjusting surfaces are intended to contact). Optionally, the adjusting surfaces can be either stationary or moveable (e.g., extendable away from another component of the adjusting tool such as a handle or a primary shaft).

In certain embodiments, each of two adjusting surfaces can be located at an end of a single or of two separate shafts extending from a handle. In particular embodiments a single (e.g., primary) shaft may extend from a handle, two separate lines or extensions can extend in different directions from the single shaft at a distal location, and one adjusting surface can be at an end of each line (or “extension”). For example, an adjusting tool may include a handle, a single shaft, and a “yoke” fixed or movably located at a distal end of the shaft; the yoke can extend in two directions from the shaft and can include one adjusting surface at the end of each extension. A line that connects the adjusting surfaces may be located to intersect a longitudinal axis of the shaft (the shaft, shaft extensions, and adjusting surfaces are contained in a single plane), or, in alternate embodiments, a line that connects the adjusting surfaces may be located to not intersect a longitudinal axis of the shaft (the shaft, shaft extensions, and adjusting surfaces are not contained in a single plane).

The adjusting surfaces can optionally be fixed or may be moveable, e.g., relative to a shaft or a handle of the tool. The adjusting surfaces may be fixed, or may be capable of being moved relative to a shaft or handle in a manner to allow the adjusting surfaces to contact and adjust an implant by contacting opposite ends of an implant (opposite self-fixating tips) or opposite ends of a piece of an implant (e.g., a support portion piece or an extension portion piece) simultaneously. For example, the adjusting tool may include a handle, a single shaft, and a “yoke” that can be stationary or that can be moved along a length of the shaft, the yoke extending in two directions from the shaft and including one adjusting surface at the end of each extension.

A distal end of a handle, shaft, or other feature of an insertion or adjusting tool may optionally be designed to contact tissue of a urethra to assist in approximating the urethra. For example, a distal end of a handle or a shaft may optionally be adapted to contact a urethra during placement or adjustment of an implant, for example by having a curved (e.g., concave) or a flat surface that approximates or matches a shape of a surface of urethral tissue (e.g., at a bulbospongiosus muscle or a corpus spongiosum) to be supported by the tissue support portion of the implant being adjusted.

FIG. **7** illustrates a system for treating urinary incontinence, the system comprising a multi-piece implant and an adjusting tool that includes two distal adjusting surfaces. Adjusting tool **96** includes handle **97**, shaft **98** extending from a proximal shaft end at handle **97** to junction **95** where the distal end of shaft **98** meets yoke (alternately opposing “yoke extensions”) **99** extending in two directions away from shaft **98**. Yoke **99** includes opening (or “gap”) **104** between its opposing extensions. Each of the two distal ends

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of each yoke extension 99 includes adjusting surface 102 that includes an extension (or “prong” or “insert” directed laterally) that is capable of engaging receiver 100.

Each receiver 100 is located at an end of adjustable support portion piece 106, and includes structure to receive adjusting surface 102 as well as a component, portion, or feature of extension portion piece 110. As shown, extension portion piece 110 includes a mesh portion 114, a non-mesh portion 112, and a self-fixating tip 116. Non-mesh portion 112 includes structure that frictionally engages receiver 100 to provide an adjusting engagement as described herein, e.g., a one-way or a two-way adjusting engagement. As illustrated, non-mesh portion 112 includes a slotted or apertured tab that has openings, slots, apertures, or surfaces that engage a one-way ratcheting structure of receiver 100. The distance of separation of surfaces 102 is about equal to the distance of separation of receivers 100, which is approximately the same as the length of support portion 106. To engage the two surfaces 102 of the two opposing yoke extensions 99 with each of the two receivers 100, one surface 102 can be initially inserted into one receiver 100. Yoke 99 can be squeezed together, e.g., by hand, to allow the spacing between surfaces 102 to be reduced, so the second surface 102 can be inserted into second receiver 100. Yoke 99 can be removed from the two receivers 100 in the same manner. The system also includes one or more insertion tool (e.g., 10, 50, or 80) (not shown) for engaging self-fixating tips 116 for placing self-fixating tips 116 into supportive tissue.

FIGS. 8A, 8B, and 8C, illustrate a method of using tool 96 and an insertion tool (e.g. 10) to place a three-piece implant having adjustable support portion piece 106 and two extension portion pieces 110, to treat urinary incontinence. Patient anatomy is as described previously. A distal end of an insertion tool (e.g., 10, not shown), engaged with self-fixating tip 116, is used to insert self-fixating tip 116 through a medial incision and at supportive tissue in a region of an obturator foramen on a first side of the patient. See FIG. 8A. The insertion tool is then used to engage the second self-fixating tip 116 and place the second self-fixating tip 116 at supportive tissue in a region of an obturator foramen on a second side of the patient.

Non-mesh portions 112 are inserted, one each, into each of the two receivers 100, to assemble an adjusting engagement between receiver 100 and non-mesh portions 112. Adjusting surfaces 102 of tool 96 are then inserted (e.g., with squeezing together of yoke extensions 99) into receivers 100. See FIG. 8B. Each non-mesh portion 112 can be pulled through receiver 100, while tool 96 is used to advance adjustable support portion 84 distally, toward the patient, to adjust lengths of extension portion pieces 110 extending from each receiver 100 to self-fixating tips 116, and to adjust the length of implant between the two self-fixating tips 116, and to provide desired tension on the length of implant and desired approximation, placement, and support of the urethra. See FIGS. 8B and 8C. Tool 96 can be removed, again by squeezing yoke extensions 99 together, allowing surfaces 102 to be removed from receivers 100. Non-mesh portions 112 can be removed by cutting.

FIG. 9A illustrates a system for treating urinary incontinence, the system comprising a multi-piece implant and a tool that includes two distal adjusting surfaces. Adjusting tool 117 includes handle 160 that includes thumb ring 164 and two finger rings 162. Shaft 118 extends from a proximal shaft end at handle 117, to surface 158, which includes two adjusting surfaces 132 defined adjacent to apertures 133. Curved and lateral surface 158 extending between apertures

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133 is sized and shaped to contact and assist in approximating tissue of a urethra (e.g., corpus spongiosum, bulbospongiosus muscle, etc.) during use of tool 117 to place an implant to support the urethra. Secondary shafts 155 extend alongside primary shaft 118. A distal end of each secondary shaft 155 includes snap-fit component 154, capable of receiving complementary snap-fit feature 150 of a proximal end of extension portion piece 170. Shaft 118 and thumb ring 164 are moveable longitudinally relative to finger rings 162, the movement being controlled by a ratcheting mechanism involving teeth 119 and reversible, lockable ratchet switch 156. Secondary shafts 155 are secured to finger rings 162 and will move with finger rings 162 as finger rings 162 are moved longitudinally along primary shaft 118.

A multi-piece implant includes support portion piece 126 and two extension portion pieces 170. Extension portion pieces 170 include a mesh portion 144, a non-mesh portion (or “adjustment portion”) 142, a self-fixating tip 146, and a male snap-fit component 150, which can engage female snap-fit component 154. Support portion piece 126 includes a surface to support a urethra and two apertures 130; each aperture 130 can be a component of an adjusting engagement with non-mesh portion 142, e.g., a grommet or other one-way (or two-way, locking) frictional engagement. As illustrated extension portion piece 170 and a distal end of each secondary shaft 155 include opposing snap-fit components to allow the extension portion piece and secondary shaft to be snap-fitted together; any alternative type of connection (e.g., a non-snap-fit mechanical engagement such as a thread, ratchet, etc.) would also be useful. Also as illustrated, snap fit component 154 is a female component (aperture) and snap-fit component 150 is a male snap-fit component (insertable into the aperture of snap-fit component 154). Alternate arrangements would also be useful. Non-mesh portions 142 include structure that frictionally engages aperture 130 to provide an adjusting engagement between aperture 130 and non-mesh portion 142, the adjusting engagement being, e.g., a one-way or a two-way adjusting engagement. As illustrated, non-mesh portion 112 includes a polymeric rod that has surfaces that engage a one-way frictional structure (e.g., grommet) at each aperture 130. The non-mesh portion of this or any other embodiment may alternately be a mesh material or an alternate form of a mesh or a non-mesh material, such as a perforated strip, a slotted strip, a tubular mesh material, or a standard mesh (e.g., mesh strip or mesh tape). A tubular mesh material may be a mesh formed, in any manner, into a tube, such as being woven or knitted into tubular form, or treated with heat (e.g., thermoformed, melted) to form a tubular mesh.

In use, after placing each extension portion piece 170 at a desired patient location, e.g., with self-fixating tips 146 at supportive tissue, support portion piece 126 can be placed over distal surface 158 of tool 117 with apertures 130 seated against apertures 133. Proximal ends of extension portion pieces 170 can be passed through aperture 130 and aperture 133, and engaged with aperture 154 of secondary shaft 155. A user can grasp handle 160 with fingers in finger rings 162 and a thumb at thumb ring 164. Movement of finger rings 162 toward thumb ring 164 causes finger rings 162 to move in a proximal direction relative to (and toward) thumb ring 164. Simultaneously, secondary shafts 154 move proximally relative to primary shaft 118, distal surface 158, and support portion piece 126. In turn, extension portion pieces 170 (engaged with secondary shafts 154) are pulled in a proximal direction relative to support portion piece 126. Surface 158, in contact with support portion piece 126, can be inserted through the medial incision to contact tissue of a

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region of a urethra, to push or otherwise contact or place pressure on the urethra, to assist in approximating the urethra. The extension portion pieces can then be drawn through apertures 130 (using the tool as described) to adjust the length of the extension portions and the location of the tissue support portion.

FIGS. 10A, 10B, and 10C, illustrate a method of using tool 117 and an insertion tool (e.g. 10) to place a three-piece implant having adjustable support portion piece 126 and two extension portion pieces 170 to treat urinary incontinence. Patient anatomy is as described previously. A distal end of an insertion tool (e.g., 10, not shown), engaged with self-fixating tip 146, is used to insert self-fixating tip 146 through a medial incision and at supportive tissue in a region of an obturator foramen on a first side of the patient. See FIG. 10A. The insertion tool is then used to place the second self-fixating tip 116 at supportive tissue in a region of an obturator foramen on a second side of the patient.

Non-mesh portions 142 are inserted, one each, through apertures 130 and 133, and snap-fit component 150 is engaged with aperture 154. See FIG. 10B. Finger rings 162 are moved proximally, toward thumb ring 164, to cause secondary shafts 154 move proximally relative to primary shaft 118. Proximal ends of extension portion pieces 170 (engaged with secondary shafts 154) are pulled in a proximal direction relative to support portion piece 126. Surface 158, in contact with support portion piece 126, can contact tissue of a region of a urethra approximate the urethra. Extension portion pieces 170 are drawn through apertures 130 to adjust the lengths of the extension portions 144 and the location of tissue support portion 126. See FIG. 10C. Upon desired placement of the assembled implant and urethra, tool 117 can be removed by cutting a proximal location of each support portion piece 170, e.g., mesh portion or non-mesh portion of support portion piece 170 that has become located on a proximal side of aperture 130.

FIG. 9B shows tool 117 and a multi-piece implant, as shown at FIG. 9A, with modifications as follows. Non-mesh portion 142 is a suture that can be threaded collet 133 (or another form of locking two-way adjusting engagement) and suture adjustment and lock 161. Tube 131 seats against collet 133, with locking collet engagement 130; all are near surface 132 and capable of maintaining the position of collets 130 of support portion piece 126 near surface 158. Suture adjustment and lock 161 is a locking or closeable two-way adjusting engagement that can be opened (to form an open two-way adjusting engagement) and closed (to lock non-mesh portion 142 relative to finger rings 162). In use, tube 131 is inserted in a distal direction into locking collet engagement 130, opening collet 133 (see inset). With suture adjustment and lock 161 (both of these) in open configurations, non-mesh portion 142 can be freely moved through each suture adjustment and lock 161. Suture adjustment and lock 161 can be closed to lock suture 142 relative to finger rings 162. Tool 160 can be used to pull non-mesh portions 142 in a proximal direction to adjust the size and position of the implant and urethra. Upon proper adjustment, tube 131 can be removed from collet engagement 130, closing collet 133 and fixing the position of non mesh portion 142 relative to support portion piece 126. Suture adjustment and lock 161 (both of these) can be opened to allow two-way movement of non-mesh portion 142 therethrough, and tool 117 can be removed proximally.

FIG. 10D shows an embodiment of a system for treating urinary incontinence having at least some structural and functional features in common with the system of FIGS. 9A and 9B. The system of FIG. 10D includes adjusting tool 117,

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including handle 160 that includes thumb ring 164 and two finger rests 162. Shaft 118 extends from a proximal shaft end at handle 160, to a distal end at yoke 165 (having two stationary shafts 157) that includes two secondary shafts 155, moveable within the yoke by movement of ring 164 relative to finger rests 162. The arrows indicate directions of proximal movements of secondary shafts 155 as finger rests 162 are moved relative to shaft 118; in a proximal direction. A distal end of each secondary shaft 155 includes a surface 154, capable of receiving complementary surface of a proximal end of an extension portion piece 170. Shaft 118 and thumb ring 164 are moveable longitudinally relative to finger rings 162, the movement being optionally controlled by a ratcheting mechanism. Secondary shafts 155 are secured to finger rests 162 and will move with finger rings 162 as finger rings 162 are moved longitudinally along primary shaft 118 (toward finger ring 164, see arrows). Surface 154, and a complementary surface of a proximal end of extension portion piece 170, can be any useful engaging or mating surfaces such as a hook and suture loop, velcro, post and hook, screw or threaded engagement, detent, a snap-fit engagement, or the like. Optional surface 158 of yoke 165, extending between stationary shafts 157, can be rigid, flexible, and may be fixed to shafts 157 or loosely engaged along shafts 157, therefore moveable (in a distal to proximal direction) relative to shafts 157 and free to float and adjust position according to an amount of pressure exerted between piece 126 (in contact with tissue) and surface 158.

In use, tool 117 can be used to install a three-piece implant having adjustable support portion piece 126 and two extension portion pieces 170, or a similar implant (see, e.g., FIG. 9B), as described hereinabove. Optionally, the system of FIG. 10D can include two extension portion pieces of different lengths. Also optionally, the system can be assembled and sold as a kit to a user (surgeon, or hospital), or can be assembled by the user, with the longer of the extension portion pieces 170 placed into an aperture 130 of support portion piece 126, and also into tool 117. Tool 117, with the assembled pieces engaged, can be used to place the anchor with the longer length at a desired location of a patient. The second anchor can be placed at a desired location within the patient using a separate tool (e.g., a tool 10, 50, 80, or the like), and the tail (optionally a shorter tail relative to the first anchor) of the second anchor, after placement of the second anchor in the patient, can then be engaged with a second aperture 130 of piece 126, and with tool 117. Subsequently, tool 117 can be used to advance (pull) anchors 170 through apertures 130 of support portion piece 126, to place desired tension and support on tissue such as a urethra, e.g. by manually moving ring 164 toward finger rests 162. Optional surface 158 extending between shafts 157 of yoke 165 can support or place pressure on support portion piece 126, which is in contact with tissue (not shown) such as a urethra (including a bladder neck), corpus spongiosus, or bulbospongiosus muscle. The pressure placed on support portion piece 126 by surface 158 allows tool 117 to be effective to adjust the position of (e.g., approximate) that tissue during placement, adjustment, or tensioning of the three-piece implant.

Optionally but not shown, tool 117 could include a cutting mechanism to cut excess length from a proximal end (e.g., 142) of anchors 170 after desired adjustment of an anchor 170 through an aperture 130. Another optional feature of a tool 117 may be a tension gauge that displays an amount of tension in a component of an implant during surgical placement, such as support portion piece 126 or an anchor 170.

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Alternately, tool **117** could include a slip-joint, clutch, or force limiter designed to apply only a maximum force on an implant e.g., anchor **170**, to prevent tool **117** from pulling a self-fixating tip **146** out of tissue.

FIG. **11** illustrates a system for treating urinary incontinence, the system comprising a single-piece implant and a tool that includes two distal adjusting surfaces, each adjusting surface attached to a separate shaft that is moveable (extendable and retractable) relative to the tool. Tool **188** includes handle **174** and primary shaft **176**. Handle **174** extends from a proximal end to surface **186** useful for contacting tissue. Two adjusting surfaces **204** are located at distal ends of moveable shafts **198**. Each adjusting surface is capable of engaging a tissue fastener such as a self-fixating tip. Surface **186** extending laterally within space between shafts **198** is sized and shaped to contact and assist in approximating tissue of a urethra (e.g., corpus spongiosum, bulbospongiosus muscle, etc.). Shafts **198** are moveable (extendable and retractable) relative to handle **174** and surface **186**, and are connected to primary shaft **176**. Shafts **198** can be moved (extended and retracted relative to handle **174**) by any mechanism, such as by movement of primary shaft **176** forward and back relative to handle **174**. The angle or splay of shafts **198** (i.e., the angle of extended shafts relative to a longitudinal axis extending through the handle) can be adjusted by movement of angle adjustment **182**.

Implant **200** as illustrated is a single-piece, e.g., integral mesh implant comprising a central tissue support portion, extension portions extending in opposite directions from the tissue support portion, and self-fixating tips **202**.

In use, with primary shaft **176** extended proximally away from handle **174**, and shafts **198** retracted into handle **174**, implant **200** can be placed at the distal end of tool **188** with self-fixating tips **202** placed at each of two distal end adjusting surfaces **204**. A user can grasp handle **174**, and adjust the angle of the shafts **198** (relative to a longitudinal axis of the tool) by movement of angle adjustment **182**. This may be referred to as a “non-extended” configuration (shafts **198** are non-extended). The distal end of tool **188**, engaged with implant **200**, can be inserted through the medial incision, whereupon surface **186** (also in contact with implant **200**) can contact tissue of a region of a urethra to push or otherwise contact or place pressure on the urethra, to assist in approximating the urethra. Shafts **198** can then be extended (simultaneously) from handle **174** by movement of primary shaft **176** in a distal (toward the patient) direction while maintaining the position of handle **174** and surface **186**. Self-fixating tips **202** become extended at distal ends of shafts **198** to contact and become secured to supportive tissue (e.g., in a region of an obturator foramen) in the pelvic region of the patient.

FIGS. **12A**, **12B**, and **12C**, illustrate a method of using tool **188** to place single-piece implant **200**, to treat urinary incontinence. Patient anatomy is as described previously. Referring to FIG. **12A**, with tool **188** in a non-extended configuration and implant **200** located at the distal end of tool **188**, the distal end, including implant **200**, is inserted through a medial incision in a patient to locate implant **200** at a location generally below a urethra. The angle of shafts **198** relative to a longitudinal axis of the tool can be adjusted (increased or decreased) by movement of angle adjustment **182**. Surface **186** (also in contact with implant **200**) can contact tissue of a region of a urethra to push or otherwise contact or place pressure on the urethra, to assist in approximating the urethra. Shafts **198** are extended (simultaneously) from handle **174** by movement of primary shaft **176** in a distal direction while maintaining the position of handle

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174 and surface **186**. Self-fixating tips **202** become extended at distal ends of shafts **198**, to contact and become secured to supportive tissue in the pelvic region of the patient.

FIGS. **12D** (top view) and **12E** (side view) show an embodiment of a system for treating urinary incontinence having at least some structural and functional features in common with the system of FIG. **11**. The system of FIGS. **12D** and **12E** comprises a single-piece implant **412** and a tool **488** that includes two distal adjusting surfaces **504**, each adjusting surface **504**, each attached to one of two separate shafts **498** that is moveable (extendable and retractable) relative to handle **474**, and relative to the other shaft (side-to-side, or laterally). The two adjusting surfaces **504** are located at distal ends of moveable shafts **498**. Each adjusting surface is capable of engaging a tissue fastener of implant **412**, such as self-fixating tip **502**. Shafts **498** are moveable (extendable and retractable) relative to handle **474** by movement of slider **476**. The angle or splay of shafts **498** (i.e., the angle between the two shafts, when extended, relative to each other or relative to a longitudinal axis extending through the handle), can also be adjusted, e.g., after the shafts are extended, as indicated by the dashed lines. Shafts **498** can be generally rigid or flexible, and can optionally be constructed of a shape memory material. Shafts **498** can be straight or curved, and may be curved in two dimensions or in three dimension (as illustrated at FIG. **12E**).

FIG. **13** illustrates a system that includes implant **222** (e.g., for treating male or female urinary incontinence) and one or more insertion tool **210**. Implant **222** includes support portion **224**, end or extension portions **226**, tissue fasteners (chevrons or barbs) **230** located on extension portions **226** near support portion **224**, tail portions (e.g., sutures) **216** extending from a distal end of each extension portion **226**, connectors or dilators **238**, and sheaths **228** which can be located along the lengths of extension portions **226** to cover tissue fasteners **230** (see FIG. **14A**) (as illustrated at FIG. **13** sheaths **228** are located over tail portions **216**). Insertion tool **210** includes shaft **212**, distal end **214**, proximal end and handle **220**, and an optional mechanical release mechanism (e.g., detent) and trigger located at a proximal region of shaft **212** (optional release mechanism and trigger are not shown). FIG. **13** shows a single tool **210**, having a helical shaft; optionally a system may include two tools **210** each having a helical shaft, one helical shaft suited to place an extension portion at a right side of a patient and one helical shaft suited to place an extension portion at a left side of the patient.

FIGS. **14A**, **14B**, and **14C**, illustrate a method of using helically-curved tool **210** to place implant **222** to treat urinary incontinence. Patient anatomy is as described previously. On a first side of a patient, distal end of helical insertion tool **210**, engaged with connector **238**, is used to insert connector **238** through a medial incision, through an obturator foramen and related tissue, around a pubic ramus bone (**34**) and then subcutaneously back to the medial, midline perineal region. See FIG. **2A**. Insertion tool **210** is then withdrawn and used to place the second connector **238** at a second side of the patient in a similar manner. See FIG. **14B**. The implant can be adjusted and tensioned by adjusting the position of the implant and the urethra, including adjusting the position and tension of tail portions **216**, which extend back to an external location through the medial incision. Once the urethra and implant are positioned as desired, sheaths **228** can be removed to expose extension portions **226**, including tissue fasteners (anchors, barbs, or chevrons) **230** within tissue. See FIG. **14C**.

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FIG. 15 illustrates a system that includes two-piece implant 242 (e.g., for treating male or female urinary incontinence), insertion tool (e.g., 10, 50, or 80), and adjusting (pusher) tool 254. Implant 242 includes a first piece that includes support portion 244, one extension portion 246 integrally connected to support portion 244, self-fixating tip 249, tissue anchors (chevrons or barbs) 245, and an aperture component 241 (e.g., grommet, channel, optionally comprising a one-way ratchet configuration) of an adjusting engagement, the aperture component 241 designed to engage a second component of the adjusting engagement. Extension portion piece 248 includes mesh portion 246, self-fixating tip 249, tissue anchors (chevrons or barbs) 245, and non-mesh portion 250, which includes a second component of an adjusting mechanism in the form of ratcheting “cones,” teeth, or another form of ratchet surface, 252. Optionally (but not as illustrated) support portion 244 can be moveable along the length of the implant between self-fixating tips 249. Optionally an adjusting tool 254 can be used to engage aperture component 241 to assist in adjusting the adjusting engagement between aperture component 241 and ratchet surface 252. A proximal end of non-mesh portions 250 can be threaded through aperture 258 at distal end 256 of tool 254, and distal surface 260, surrounding aperture 258, can contact aperture component 241 to place pressure on aperture component 241 while non-mesh portion 252 is drawn in a proximal direction (see arrow).

FIGS. 16A, 16B, and 16C, illustrate a method of using an insertion tool (e.g., 10) and adjusting tool 254 to place two-piece implant 242 to treat urinary incontinence. Patient anatomy is as described previously. A distal end of an insertion tool engaged with self-fixating tip 249 is used to insert self-fixating tip 249 through a medial incision and place self-fixating tip 249 at supportive tissue in a region of an obturator foramen on a first side of the patient. See FIG. 16A. The insertion tool is then used to engage the second self-fixating tip 249, and the second self-fixating tip 249 can be placed at supportive tissue in a region of an obturator foramen on a second side of the patient. A proximal end of non-mesh portion 250 can be placed through an aperture of aperture component 241 and pulled to adjust a length of implant between self-fixating tips 249, to provide desired tension on the length of implant, and desired approximation, placement, and support of the urethra. See FIGS. 16B and 16C. Proximal end 250 may optionally be threaded through aperture 258 of pusher tool 254, and pusher tool 254 may optionally be used to push aperture component 241 in a distal direction, toward self-fixating tip 249 located at the distal end of mesh portion 246 of extension portion piece 248. A proximal portion of non-mesh portion 250 can then be removed by cutting. Before, after, or simultaneously with reducing the length of implant by pulling non-mesh portion 250 relative to aperture component 241, an optional moveable support portion (not shown) can be moved (slid) laterally in a direction toward one or the other obturator foramen to place the moveable support portion at a desired (central, medial) location below the urethra.

FIG. 17A illustrates a system that includes implant 281 (e.g., for treating male or female urinary incontinence) and insertion tool 290. Implant 281 includes support portion 284, end or extension portions 286, self-fixating tips 288, and tissue fasteners (chevrons, barbs) 289. Support portion 284 is moveable relative to self-fixating tips 288 by passage through supports 285 located on support portion 284. Supports 285 are adjusting engagements that allow support portion 284 to be moved and positioned at a desired location along a length of each extension portion 286. The effect is

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to allow a user to reduce (or optionally increase) the effective size of each extension portion by sliding each support 285 toward a respective self-fixating tip 288, on one or both sides of the implant and patient, thereby reducing the overall length of implant 281 between self-fixating tips 288. As illustrated, supports 285 include ratcheting springs 287, which are biased toward and contact perforations 283 of extension portions 286, resulting in a one-way adjusting engagement between a support 285 and a perforated extension portion 286.

FIG. 17B shows details of an exemplary tool 290, wherein handle 299 is moved proximally (away from the patient) to draw shaft 293 in the proximal direction. Tool 290 can also optionally include a gauge to measure a state of adjustment of the implant during placement and adjustment, including tension in the implant during adjustment. For example, a gauge may measure the amount of tension applied to the extension portions of the implant by use of a pressure gauge that measures pressure at surface 292. Alternately, a gauge may be used to measure pressure of tissue (e.g., corpus spongiosum) that becomes applied to a distal end of the tool, e.g., at surface 294.

In use, after placement of self-fixating tips at a left and a right side of a patient, tool 290 can be used to moved supports 285 distally along support portions 286, toward self-fixating tips 288, to shorten the length of implant between self-fixating tips 288. Movement of supports 285 can be assisted by use of tool 290, which includes distal surface 294 at an end of stationary shaft 296. Surface 294 is capable of contacting and approximating support portion 284, placed in contact with tissue of a urethra (e.g., corpus spongiosum, bulbospongiosus muscle). Puller 292 is located behind surface 294 and at a distal end of moveable shaft 293. To adjust lengths of extension portions 286, proximal loop 276 is placed on a proximal side of puller 292, as surface 294 is placed against support portion 284, in contact with tissue of a urethra, and after self-fixating tips are placed in supportive tissue. Moveable shaft 293 is advanced in a proximal direction (see arrows), causing support portion 284 to move distally along lengths of extension portions 286 and toward self-fixating tips 288; i.e., proximal portions of extension portions 286 are pulled in a proximal direction through supports 285. The result is to shorten the length of implant between self-fixating tips 288, while approximating the urethra, and thereafter supporting the urethra with implant 281.

FIGS. 17C and 17D show details of another example of a tool 590 having at least some structure and utility in common with tool 290. Tool 590 includes handle 589, trigger 599, moveable (inner) shaft 593 with proximal toothed section 597, and distal engagement surface 592. Tool 590 also includes distal surface 594 at a distal end of stationary (outer) shafts 596. Trigger 599 is can be moved proximally (away from the patient) to draw moveable (inner) shaft 593 in a proximal direction. Upon proximal movement (see arrows), teeth 588 connected to handle 599 engage toothed section 597, drawing shaft 593 proximally relative to handle 589 and shafts 596. After a desired length of proximal draw of shaft 593, a user can push (depress) button 586 to release teeth 588, allowing shaft 593 to be moved distally, e.g., to a starting position.

Tool 590 can also optionally include a gauge to measure a state of adjustment of an implant during placement and adjustment, including tension along a length of the implant during adjustment. For example, a gauge may measure the amount of tension applied to extension portions of the implant by use of a pressure gauge that measures pressure at

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an engagement surface 592. Alternately, a gauge may be used to measure pressure of tissue (e.g., corpus spongiosum) that becomes applied to a distal end of the tool, e.g., at surface 294. Alternately, tool 590 may include a slip-joint, clutch, or force limiter designed to apply only a maximum force on an implant, to prevent tool 117 from pulling a self-fixating tip of the implant out of tissue.

Tool 590 can be used to adjust tension of an implant as shown at FIG. 17A. In use, after placement of self-fixating tips at a left and a right side of a patient (e.g., at opposing obturator foramen), tool 590 can be used to moved supports 285 distally along support portions 286, toward self-fixating tips 288, to shorten the length of implant between self-fixating tips 288. Movement of supports 285 can be assisted by use of tool 590, which includes distal surface 594 at an end of stationary shafts 596. Surface 594 is capable of contacting and approximating support portion 284, placed in contact with tissue of a urethra (e.g., corpus spongiosum, bulbospongiosus muscle). Engagement surface 592 is located behind surface 594 and at a distal end of moveable shaft 593. To adjust lengths of extension portions 286, proximal loop 276 is placed on engagement surface 592, as surface 594 is placed against support portion 284, in contact with tissue of a urethra, and after self-fixating tips 288 are placed in supportive tissue. Moveable shaft 593 is advanced in a proximal direction (see arrows), causing support portion 284 to move distally along lengths of extension portions 286 and toward self-fixating tips 288; i.e., proximal portions of extension portions 286 are pulled in a proximal direction through supports 285. The result is to shorten the length of implant between self-fixating tips 288, while approximating the urethra, and thereafter supporting the urethra with implant 281.

FIGS. 17E-17G illustrate an exemplary tool 700 that generally includes an end effector 702 that is slideable relative to a pulling member 704. End effector 702 includes an elongated member 706 that extends between a proximal thumb ring 708 and a distal tip 710. Pulling member 704 includes a central body 712 and a pair of finger rings 714 located on opposite sides of elongated member 706 of end effector 702. Body 712 can include a back panel 716 and a mating front panel 718 that can be positioned to cover at least a portion of the back panel 716. In this embodiment, the front panel 718 only covers a portion of the back panel 716, although it is possible that the back and front panels 716, 718 can be configured as mirror images of each other so that the front panel 718 also extends to the areas of the finger rings. The interior area of the back panel 716 is best illustrated in FIG. 17G, where the front panel 718 is not shown in this figure in order to better view the inner features of the back panel 716. Both of the back and front panels 716, 718 further include a slot 720 that extends generally in the same direction as the direction that the end effector 702 can slide relative to the pulling member 704. When tool 700 is assembled, the back and front panels 716, 718 can be secured to each other at one or more attachment points 722, such as with screws, rivets, or other fasteners, or the panels may alternately be secured to each other using any conventional attachment means, such as using snap-fit connectors, adhesives, welding, or the like.

In this exemplary embodiment, tool 700 further includes a limiter 730, which is best illustrated in FIG. 17G as positioned relative to the back panel 716. Limiter 730 includes a spring 732 operatively positioned for interaction with a spring rod 734. Spring rod 734 is configured as a flattened U-shape, including a cross-member 736, and upwardly extending members 738, 740 at proximal and

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distal ends of the cross-member 736, respectively. Proximal extending member 738 is positioned so that its distal (upper) end is adjacent to slot 720. A pull force indicator 742 extends through the width of the proximal extending member 738 and through the slots 720 of both the back and front panels 716, 718. Indicator 742 may be a dowel pin, for example, that can be press-fit or otherwise secured into an aperture of the proximal extending member 738. As best illustrated in FIG. 17F, indicator 742 extends at least slightly past the outer surface of the back and front panels 716, 718 so that the ends of the indicator 742 are visible when looking downward at the top of the tool 700. Alternatively, the indicator 742 can consist of two or more pieces, such as separate dowel pins that extend from opposite sides of the proximal extending member 738 but do not extend through its width.

Upwardly extending member 740 of spring rod 734 can include an extending lip 744 at its distal end, which can extend beyond the outer surface of member 740 in at least one direction around its periphery. In this embodiment, the lip 744 extends past the periphery of member 740 only in the area that faces toward a proximal end of the tool 740, although the lip 744 can extend in additional directions. This lip 744 can be used for engagement with an implant, as will be described below in further detail.

Referring again to FIG. 17G, spring 732 includes a proximal end 746 and a distal end 748. Proximal end 746 of spring 732 is positioned to abut the extending member 738 adjacent to the intersection area between the proximal extending member 738 and the cross-member 736. The spring 732 is positioned so that it is adjacent to central body 712 along its length (i.e., in the space between back and front panels 716, 718) and so that it extends along a portion of the length of cross member 736. One or both of the back and front panels 716, 718 can further include a stop 746 extending into a space created by contours of the interior surfaces of these panels. The stop 746 is provided for engagement with distal end 748 of spring 732 and also provides a surface against which the spring 732 can be compressed.

Limiter 730 can function, among other things, to control the distance that end effector 702 can travel relative to pulling member 704. The entire distance that the spring rod 734 can travel relative to the pulling member 704 is controlled by the slack in an attached implant, by the length of the slot 720, and/or by the amount of force that is measured by the indicator 742. In operation, a proximal loop of a two-piece implant, such as proximal loop 276 of the implant 281 illustrated relative to FIG. 17A, can be engaged with distal extending member 740. The extending lip 744 of extending member 740 can provide a securing surface or stop that prevents the proximal loop 276 from slipping off of extending member 740 once it is positioned thereon. Extension portions 286 of implant 281 can be fixed to tissue in a patient, and support portion 284 is moveable relative to the length of each of the extension portions 286 with use of tool 700. In this way, a user can reduce the effective length of each extension portion by sliding supports 285 toward the distal ends of these extension portions. In particular, distal tip 710 can be positioned to contact a support portion of an implant (e.g., support portion 284), while the proximal loop 276 is positioned over the distal upwardly extending member 740. To move the pulling member 704 relative to the end effector 702, a user's fingers can be placed in the finger rings 714, the user's thumb can be placed in the thumb ring 708, and the pulling member 704 can be moved proximally relative to the thumb ring 708. Once any slack has been taken up in the implant, the extension portions of the implant

will be placed in tension. This tension can be increased by further moving the pulling member **704** proximally relative to the end effector **702**, thereby compressing the spring **732**. The amount of tension on this spring **732** can optionally be monitored by observing and/or recording the movement of the pull force indicator **742**. A user can either stop movement of pulling member **704** once the indicator **742** has travelled a predetermined distance, or can continue movement of the pulling member until the indicator has moved to the distal end of the slot **720**.

In one particular embodiment of the tool **700**, the spring **732** is a force limiting spring of the type available from McMaster-Carr as a 9657K57 spring that has a $\frac{3}{16}$ " outer diameter, a free length of 1.375", and a 9.99 lb./in. spring rate. The spring **732** can be installed with a 0.025" preload. With such a spring configuration, this system is designed for 0.475" of travel to achieve 5 pounds of force in the spring. However, any or all of these particular spring and travel features can be modified to suit the particular desired performance of tool **700**.

Tool **700** can further include a locking mechanism for holding the limiter **730** in a particular position until it is desired to move the pulling member **704** relative to the end effector **702**. One such locking mechanism is the lock lever **760** illustrated in FIGS. 17E and 17F. Lock lever **760** includes an elongated arm **762** at its distal end that branches into front and back arms **764**, **766**, respectively. Each of the arms **764**, **766** is secured at its proximal end to the pulling member, such as at attachment point **768**, for example. Each of the arms **764**, **766** further includes a cylindrical member **770** and a spring **772**. In order to allow the pulling member **704** to be moved relative to the end effector **702**, the elongated arm **762** is moved toward the distal tip **710** of the end effector **702**.

Although the limiter **730** is described herein as used with tool **700**, it is understood that this limiter can also be used with other tools of this type that include sliding movement of two elements or components relative to each other for which it would be desirable to control the distance and/or force required for movement of these elements.

FIGS. 18A, 18B, and 18C, illustrate a method of using an insertion tool (e.g., **10**, **50**, or **80**) and adjusting tool **290** to place implant **281** to treat urinary incontinence. Patient anatomy is as described previously. A distal end of an insertion tool is used to place self-fixating tips **288** at a region of an obturator foramen on a first side and a second side of the patient. See FIGS. 18A and 18B. Adjusting tool **290** is then used to adjust the placement of the implant and the location of the urethra. For example, proximal loop **276** can be placed on a proximal side of puller **292** as surface **294** is placed against support portion **284** and in contact with tissue of a urethra. Tool **290** can be used to approximate tissue of the urethra as desired. Moveable shaft **293** is advanced in a proximal direction causing support portion **284** to move distally along the lengths of extension portions **286** and toward self-fixating tips **288**; i.e., proximal portions of extension portions **286** are pulled in a proximal direction through supports **285**. The result is to shorten the length of implant between self-fixating tips **288** while approximating the urethra, and thereafter supporting the urethra with implant **281**. Tool **290** can be removed and proximal loop **276** can be cut away.

FIG. 19 illustrates a system for treating urinary incontinence, the system comprising a multi-piece implant and an adjusting tool. The system shares structural features with the systems illustrated elsewhere herein, including the systems of FIGS. 7 and 9, and can be used in methods as described

for those systems to place an implant into a patient using steps analogous to steps identified as useful with those systems. Adjusting tool **317** includes handle **360** and distal adjusting surface **364**, in contact with support portion piece **362**. Shaft **318** extends from a proximal shaft end at handle **360** to surface **364** defined adjacent to aperture **333**. The curved distal surface **364** adjacent to aperture **333** is sized and shaped to contact and assist in approximating tissue of a urethra (e.g., corpus spongiosum, bulbospongiosus muscle, etc.) during use of tool **317** to place an implant to support the urethra.

A multi-piece implant includes support portion piece **362** and two extension portion pieces **370**. Extension portion pieces **370** include a mesh portion **344**, a non-mesh portion **342**, and self-fixating tip **346**. Support portion piece **326** includes a surface to support a urethra having two apertures **330**; each aperture **330** can be a component of an adjusting engagement with non-mesh portion **342** or mesh portion **344**. Non-mesh portions **342** include a surface or structure that can frictionally engage an aperture **330** to provide an adjusting engagement between aperture **330** and non-mesh portion **342**, the adjusting engagement being, e.g., a one-way or a two-way adjusting engagement. As illustrated, non-mesh portion **312** includes a polymeric rod that has surfaces that engage a one-way frictional structure (e.g., grommet) at each aperture **330**.

In use, after placing each extension portion piece at a desired patient location, e.g., as described herein with self-fixating tips at supportive tissue, support portion piece **326** can be placed at distal surface **364** of tool **317** with apertures **330** seated to be accessed through aperture **333**. Proximal ends of extension portion pieces **370** can be passed through aperture **330** and aperture **333**. A user can grasp (by hand or by use of a tool) a proximal end of each support portion piece **370** to pull the proximal end in a proximal direction. Simultaneously, surface **364** can be used to approximate tissue of a urethra by inserting the distal end of tool **317** through a medial incision to contact tissue of a region of a urethra, to push or otherwise contact or place pressure on the urethra, to assist in approximating the urethra. The extension portion pieces can be drawn through apertures **330** to adjust the length of the extension portions and the location of the tissue support portion.

FIG. 20 illustrates a system for treating urinary incontinence, the system comprising a multi-piece implant and an adjusting tool. The system shares structural features with the systems illustrated elsewhere herein, including the systems of FIGS. 7, 9, and 19, and can be used in methods as described for those systems to place an implant into a patient using steps analogous to steps identified as useful for those systems. Compared to the system of FIG. 19, the system of FIG. 20 includes similar features that include adjusting tool **317**, handle **360**, distal adjusting surface **364**, support portion piece **362**, extension portion pieces **370**, shaft **318**, and surface **364** defined adjacent to aperture **333**. As one difference, extension portion piece **370** of FIG. 20 includes a proximal portion made of mesh (as a replacement for the non-mesh portion). Also, tool **317** includes moveable holder (e.g., slider or "shuttle") **372** moveable along a length of shaft **318**, and guides **374** located at a distal end of shaft **318**, near surface **364**. During use, proximal mesh portion **342** is guided through aperture **330** of support portion piece **362**, through guide **374** at a distal end of shaft **318**, and then can removably engage slider **372** by a removable mechanical connection such as a cleat, slot, slit, moveable jaws, a moveable frictional device, or any mechanical securing device. Slider **372** can be moved in a proximal direction to

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pull extension portion pieces in a proximal direction (toward handle **360** along shaft **318**) relative to support portion **362** located against surface **365**, while the distal end of tool **317** is used to approximate urethral tissue.

FIG. **21** illustrates a system for treating urinary incontinence, the system comprising a multi-piece implant and an adjusting tool. The system shares structural features with the systems illustrated elsewhere herein, including the systems of FIGS. **7**, **9**, **19**, and **20**, and can be used in methods as described as useful with those systems. Compared to the system of FIGS. **19** and **20**, the system of FIG. **21** includes similar features, identified numerically in a consistent manner. As one difference, extension portion piece **370** of FIG. **21** includes a non-mesh portion **380** that includes apertures. Non-mesh portion **380** can be threaded through buckle **378** of support portion piece **326** to allow apertures of the non-mesh portion to selectively engage and disengage buckle **378**. The adjusting engagement between support portion piece **362** and extension portion pieces **370** is capable of being engaged, disengaged, adjusted, re-engaged, and disengaged, adjusted, and re-engaged as necessary. The adjusting engagement is a two-way engagement that can be selectively secured (e.g., “locked into place”), unsecured, and re-secured. Each support portion piece **370** can be used as described, by engaging supportive tissue, then threading support portion pieces **370** through buckles **378**. Each support portion piece **370** can then be individually engaged (through an aperture **380**) with buckle **378** and the implant can be tested for positioning, tension, or support of the urethra. If desired, each support portion piece can be independently disengaged from buckle **378**, adjusted, then re-engaged. Upon proper placement, support, tension, etc., a proximal portion of each support portion piece can be trimmed.

FIG. **22** illustrates another system for treating urinary incontinence, the system comprising a multi-piece implant and an adjusting tool. The system shares structural features with systems illustrated elsewhere herein, including the systems of FIGS. **7**, **9**, **19**, **20**, and **21**, and can be used in methods described as useful for those systems. Compared to the system of FIG. **20**, the system of FIG. **22** includes similar features that include adjusting tool **317**, handle **360**, distal adjusting surface **364**, support portion piece **362**, extension portion pieces **370**, shaft **318**, slider or “shuttle” **372**, and surface **364** defined adjacent to aperture **333**. As a difference, aperture piece **330** (e.g., of a metal such as stainless steel) is a two-way adjusting engagement that can be closed or locked (e.g., mechanically crimped) to prevent subsequent movement of non-mesh portion **342** after adjustment of extension portion piece **370**.

FIGS. **23**, **24**, and **25** depict embodiments of a multi-piece (e.g., two piece or three piece) implant **412** having at least one extension or elongate portion **440** and a distinct or separate support portion **418**. A self-fixating tip **416**, and optional tissue fastener **417** are located at distal ends of elongate portions **440**. A connection feature **470** provides an adjusting engagement between each extension portion **440** and support portion **418**. The connection feature **470** can include an open (non-frictional) aperture or slot, a buckle device, a frictional grommet, a tie feature, or another form of frictional or non-frictional adjusting engagement, and can be included as part of an extension **440**, as part of support portion **418**, or both, to enable selective and adjustable attachment of the implant components. FIG. **25** shows an example of a frictional aperture (e.g., slot) **441** that includes frictional surfaces in the form of teeth or keys that allow for one-way movement of elongate portion **440** through slot **441**

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in a direction to tighten the implant (shorten a length of an extension portion between self-fixating tip **416** and support portion **418**), but that does not easily allow movement in the opposite direction. As detailed herein and as shown at FIG. **23**, support portion **418** can be wider than the respective extension portions **440**.

As shown at FIG. **24**, implant support portion **418** can be placed surgically in a patient by use of an insertion tool, including but not necessarily a tool **290** as described herein and as shown at FIGS. **17A** through **17F**). Tool **290** (or another tool suitable tool as described herein, e.g., **590**, **700**) can be used to insert, deploy, position, adjust, and place and adjust tension upon implant **412** within the patient. Tool **290** can include outer stationary shafts **296**, inner moveable shaft **293**, and features of tool **290** of FIG. **17D**, or the like. Alternately, as a variation of tools shown at FIGS. **17A-17F**, tool **290** of FIG. **24** can grasp extension portions **440** on a proximal side of support portion **418** and pull proximally (see arrow), and locking disk **92** (e.g., a one-way frictional grommet) may be advanced distally (e.g., using a grommet advancement mechanism (not shown) of tool **290**), to secure desired tension and placement of extension portions **440** and support portion **418**. Optionally, excess length of extension portions **440** that will be produced on a proximal side of locking disk **92** can be cut off and removed, optionally but not necessarily using a distal end cutting mechanism (not shown) of tool **290**.

FIGS. **26** through **34** illustrate alternate embodiments of implants, insertion tools, adjusting tools, implant components (e.g., connectors), and related methods. Two piece implant **512** includes a first piece (e.g., a support portion piece) that includes extension portion **540a**, support portion **518** moveable lengthwise along extension **540a**, one or more anchors **516** at a first (e.g., distal) end, and connector (e.g., adjustable connector) **584** at a second (e.g., proximal) end. The second piece (e.g., extension portion piece) of implant **512** includes extension portion **540b** at a proximal end, and one or more anchor **516** at a distal end.

FIG. **30** is a more detailed illustration of extension **540a** and support portion **518**. Support portion **518** includes two slots, at ends of support portion **518**. Extension **540a** is threaded through each slot, and support portion **518** can slide along a length (see arrows) of support portion **540a**. Dimensions of support portion **518** include a width that is greater than a width of extension **540a**.

FIG. **31** shows an example of a delivery tool or “insertion tool” (or adjusting tool) useful in combination with the implant and methods of FIGS. **26-34**. Tool **580** includes handle **514**, shaft **586**, which may be straight or curved, a detent (or other engagement mechanism) at distal end **587** of shaft **586**. An actuator or release mechanism **515** is located at handle **514**, to allow release of the detent at distal end **587**. In use as an insertion tool, a self-fixating tip such as **516** attaches to distal end **587** of shaft **586** and is held in place by the detent. Upon desired placement of self-fixating tip **516** at a desired anatomical location, release mechanism **515** is actuated (e.g., depressed), and distal end **587** can be withdrawn or otherwise dis-engaged from self-fixating tip **516**. Optionally, distal end **587** of insertion tool **580** can be adapted to engage an aperture, slot, or opening of two or more of, e.g., all three of: the self-fixating tip of the support portion piece, the self-fixating tip of the extension portion piece, and the connector (as an adjusting tool).

FIG. **32A** shows an example of a self-fixating tip **516**, which includes an aperture (e.g., slot) that engages distal end **587** of shaft **586** of tool **580**. Self-fixating tip **516** is also engaged (e.g., securely, such as by injection molding) to

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extension portion **540b**. Self-fixating tip **516** can include structure that is complementary to a detent or retaining structure at distal end **587**. In use, a tool, e.g., **580**, can be used to engage self-fixating tip **516** and place self-fixating tip **516** at a desired anatomical location, such as an obturator foramen. Upon such desired placement, self-fixating tip **516** can be released (optionally by actuation of a release mechanism **515**), and tool **580** can be withdrawn.

Referring to FIG. 32B, connector **584** (shown in two different end perspective views) can be any connector capable of producing an adjustable engagement between extension portions **540a** and **540b**, and optionally being able to engage a distal end of an adjusting tool (e.g., **580**) to allow manipulation of connector **584** during surgical placement of implant **512**. As illustrated (e.g., in detail at FIGS. 33 and 34), connector **584** is located at an end of the extension portion **540a**, opposite of anchors **516**. According to exemplary adjustable engagement structures, connector **584** can be securely engaged (e.g., by injection molding) to extension portion **540a**, and adjustably engaged to extension portion **540b**, or vice versa. An adjustable engagement may include one or more of a buckle device, tie, snap-fit, grommet, ratchet, or other mechanism that allows movement of one extension portion (**540a** or **540b**) through an aperture, hole, or channel of connector **584**, while the connector is securely engaged to the other extension (**540b** or **540a**, respectively).

As illustrated at FIG. 32B, a connector **584** can include a proximal end **601** and a distal end **603**, connected by a (optionally tapered) body that includes one or multiple apertures or channels extending between the proximal end and the distal end. One aperture or channel can be adapted to engage a distal end of an adjusting tool. The other aperture can be adapted to adjustably engage an extension portion (**540b** or **540a**). As illustrated, proximal end **601** is securely engaged at an end of an extension portion (e.g. **540a**) by a desired mechanism such as an adhesive, thermoforming, injection molding, or other engagement. Proximal end **601** includes two apertures (e.g., slots) **585** and **587**. Aperture **585** is part of an adjustable engagement that allows adjustable passage of an extension portion (e.g., **540b**) through connector **584**. As illustrated, aperture **585** connects to a channel that extends between proximal end **601** and distal end **603**, ending at slot **589**. The channel is sized to adjustably, e.g., frictionally, engage a length of extension portion **540b**. A frictional detent or other surface such as a tab, teeth, or any other type of (preferably one-way) frictional structure can allow for frictionally-inhibited (e.g., one-way) movement of extension portion **540b** through the channel connecting slot **585** and slot **589**.

Proximal end **601** also includes aperture **587**, which can extend partially or completely through the length of connector **584**, as desired. Aperture **587** leads to a channel or other opening along a full or partial length of connector **584**. Aperture **587** and the connected channel are adapted to engage a distal end of a needle (e.g., **586**) of an adjusting tool. As shown at FIG. 32B, aperture **587** connects to a channel (not shown) that extends between proximal end **601** and distal end **603**, ending at slot **605**. In alternate embodiments, aperture **587** may connect to a channel that extends only partially through connector **584**, not passing through the entire length between proximal end **601** and distal end **603**. In use, the distal end of the adjusting tool can be connected to connector **584** at aperture **587**, to allow the adjusting tool to be used to manipulate connector **584** during

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placement of implant **512**, and adjustment of the tension placed along the length of implant **512**, while implant **512** supports pelvic tissue.

FIGS. 26, 27, 28, and 29 show an exemplary sequence of steps that can be useful to place an implant **512**. As shown at FIG. 26, a first piece of implant **512** can be placed through a central incision in a male or female patient, e.g., below a urethra. A tissue path is formed between the central incision and an obturator foramen, and anchor or anchors **516** (e.g., a self-fixating tip) are inserted through the tissue path and secured at an obturator foramen. The first piece can be a support portion piece that includes a support portion **518**, extension portion **540a**, one or more anchors **516**, and (as illustrated) connector **584**. Optionally and preferably, an insertion tool (e.g., **580**) can be used to place the self-fixating tip at the obturator foramen.

In a separate step, either previous or subsequent to the step described immediately above, a second piece of implant **512** can be placed through the same incision, and through at tissue path extending to a location at the opposite obturator foramen. The second piece can be an extension portion piece that includes extension portion **540b**, and one or more anchors **516**. Optionally and preferably, an insertion tool (e.g., **580**) can be used to place self-fixating tip **516** of the second piece of implant **512**, at the second obturator foramen.

Before or after placement of the two pieces with ends at the opposing obturator foramen, extension portion **540b** can be engaged with connector **584**. According to exemplary embodiments, see FIGS. 32B, 33, and 34, an end of extension portion **540b** can be threaded through an aperture (e.g., **589**) at distal end **603** of connector **584**, to exit through an aperture (e.g., **585** at proximal end **601** of connector **584**). Optionally, during a placement or adjustment step, connector **584** can be manipulated by connecting a distal end of an adjusting tool (e.g., **580**) to connector **584**, such as at aperture **587** (see FIG. 38). Extension portions **540a** and **540b** can be adjusted relative to each other at connector **584** to produce desired tension and supportive pressure on implant **512**. With ends of both pieces of implant **512** secured to opposing obturator foramen, the length and tension of implant **512** can be adjusted by pulling a length of extension portion **540b**, on a proximal side of connector **584**, proximally (see arrow at FIG. 38), as pressure in a distal direction (see arrow at FIG. 38) is placed on connector **584** engaged at distal end **587** of shaft **586** of the adjusting tool. A location of support portion **518** can also be adjusted along the length of implant **512**, to be placed below desired tissue (e.g., of a urethra or adjacent tissue).

According to certain preferred methods of treating incontinence in a male, using implants as described, an implant can be placed below a urethra to contact tissue of a corpus spongiosum (by dissecting bulbospongiosus muscle), and the urethra can be approximated to improve continence without requiring the urethra to be compressed.

As described more specifically in US 2006-0287571-A1, according to exemplary embodiments of treating incontinence using any of the implants or tools described herein, a tissue support portion of an implant can be placed in a position to approximate and support a urethra, optionally without placing compressive forces on the urethra, to effect improved continence (e.g., in a male patient). Preferably, for treatment of a male patient, a tissue support portion can be placed to contact tissue of a corpus spongiosum and then tensioned to cause approximation of the corpus spongiosum and urethra in a direction toward a bladder, optionally with use of a tool as described herein for placing pressure on or

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moving the urethra. Accordingly, embodiments of the invention generally, in a male patient, can relate to placement of a tissue support portion at a location that supports and is tensioned to re-position a urethra toward a bladder. The implant can be tensioned to cause the urethra—especially the posterior portion of urethra above a perineal membrane—to be moved from an abnormal (e.g., prolapsed or descended) position to a position of normal healthy urethral tissue capable of being fully coapted upon contraction of the rhabdosphincter. Alternate methods can cause compression of the urethra, but compression is not required in methods that result in approximation of the urethra to improve continence.

According to these embodiments, a method of surgically installing a urethral implant can include providing a medial incision at the perineum of a male patient to expose bulbospongiosus muscle, optionally and preferably dissecting through bulbospongiosus muscle to expose corpus spongiosum, and placing a tissue support portion of the implant to contact the corpus spongiosum tissue. Optionally the tissue support portion can be fixed to the corpus spongiosum, such as by use of a medical attachment in the form of a suture, staple, adhesive, or the like. The implant can be adjusted, tensioned, etc., e.g. based on the use of an adjusting engagement, an adjustment tool, or another means, to approximate the urethra to improve continence, and tension can optionally and preferably be maintained chronically.

According to exemplary methods, the implant can be inserted through a single medial (perineal or vaginal) incision (no external incision is required) and an extension portion of the implant can be attached to supportive tissue within the pelvic region, such as tissue at a region of an obturator foramen, or to tissue (e.g., fascia) that lies between a urethra and tissue of an obturator foramen, or other supportive tissue. According to such methods, a tissue fastener such as a self-fixating tip at a distal end or distal portion of an extension portion can be engaged at a distal end of an insertion tool (e.g. a curved elongate needle). The insertion tool can be used to place the tissue fastener and extension portion through a medial incision (of a male or female patient) and extend the tissue fastener and extension portion in a direction of an obturator foramen, e.g., to tissue of the obturator foramen or to other supportive tissue. Features of the inventive methods, implants, and tools that are described herein can be incorporated into such a technique, such as placement of the urethral sling below a urethra at a tissue of a bulbospongiosus muscle or a corpus spongiosum, approximation of the urethra to improve continence (without the need for compression of the urethra), etc., use of an implant that includes adjustable engagements (and steps of adjusting the implant), use of an adjustment tool. This method avoids the need for lateral incisions at the inner thigh and adjacent to each opposing obturator foramen.

The invention claimed is:

1. An implant and adjusting tool for treating urinary incontinence, the implant comprising:

a support portion piece comprising a proximal end, a distal end, an extension portion, a tissue support portion, and a self-fixating tip at the distal end,

an extension portion piece comprising a proximal end, a distal end, an extension portion, and a self-fixating tip at the distal end of the extension portion piece, and

a connector secured to the support portion piece, the connector comprising a first aperture that adjustably engages the extension portion piece, and a second aperture comprising a channel; and

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the adjusting tool comprising a handle, an elongate shaft, and a distal end;

wherein the channel of the second aperture is adapted to engage the distal end of the adjusting tool while the first aperture is engaged with the extension portion piece,

wherein the connector comprises a proximal end and a distal end, the first aperture comprising a channel extending from the proximal end of the connector to the distal end of the connector, the channel of the second aperture extending from the proximal end of the connector at least partially to the distal end of the connector.

2. The implant and adjusting tool according to claim 1 further comprising an insertion tool that is adapted to engage the self-fixating tip of the support portion piece, the self-fixating tip of the extension portion piece, or both.

3. The implant and adjusting tool according to claim 1 wherein the proximal end of the extension portion piece extends through the first aperture to adjustably connect the extension portion piece to the support portion piece.

4. The implant and adjusting tool according to claim 1 wherein the adjusting engagement is a one-way adjusting engagement.

5. The implant and adjusting tool according to claim 1 wherein a length of the support portion piece is different from a length of the extension portion piece.

6. A method of treating incontinence in a male or female patient, the method comprising:

providing the implant and adjusting tool of claim 1, placing the self-fixating tip of the support portion piece at an obturator foramen on one side of the patient, placing the self-fixating tip of the extension portion piece at an obturator foramen on one side of the patient, placing the tissue support portion at a location to support tissue of a urethra,

adjustably engaging the proximal end of the support portion piece to the proximal end of the extension portion piece.

7. The method according to claim 6 wherein the patient is a male patient and the method comprises exposing bulbospongiosus muscle, dissecting bulbospongiosus muscle to expose corpus spongiosum, and placing the tissue support portion to contact the corpus spongiosum.

8. A system useful to treat urinary incontinence, the system comprising a multi-piece implant comprising a support portion piece, two extension portions, and an adjusting tool,

wherein the support portion piece comprises a tissue support portion sized and shaped for placement to support a urethra,

the extension portions each comprise a proximal end, a distal end, and a self-fixating tip,

the first extension portion is capable of being adjustably connected to the support portion piece at a first adjusting engagement,

the second extension portion is capable of being adjustably connected to the support portion piece at a second adjusting engagement,

the adjusting tool comprising:

a surface adapted to engage one of the two extension portions and to place tension on the extension portion,

an end effector including an elongate shaft,

a pulling member slideably positioned relative to the elongate shaft and slidable along a length of the shaft, and

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a force limiter comprising a spring connected to the surface and adapted to limit a force applied to the extension portion by the surface during surgical placement of the implant, the force limiter including a spring rod operatively coupled to the spring, the spring rod including a proximal extending member, the pulling member being operatively connected to a distal end of the spring, the proximal extending member being operatively connected to a proximal end of the spring,

wherein the spring has a longitudinal axis, the longitudinal axis being oriented substantially parallel to the length of the elongate shaft.

9. The system according claim 8

wherein the end effector includes a distal end tip, and a thumb ring at a proximal end of the elongated member; the pulling member comprising a main body adjacent to the elongated member of the end effector, and two finger rings positioned on opposite sides of the elongated member,

the spring being operatively connected to the pulling member for controlling slideable movement of the pulling member relative to the end effector.

10. The system according claim 8 wherein the spring rod comprises a cross member, and an upwardly extending

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member at each of proximal and distal ends of the cross member, and wherein the upwardly extending member is operatively connected to a slot of the main body of the pulling member.

11. The system according claim 10 wherein the force limiter comprises a pull force indicator that extends beyond at least one outer surface of the pulling member.

12. The system according to claim 8 wherein at least one of the first adjusting engagement and the second adjusting engagement is selected from: a one-way adjusting engagement, a two-way adjusting engagement, and a locking two-way adjusting engagement.

13. A method of treating urinary incontinence, the method comprising

providing the system of claim 8,

placing the self-fixating tip of the first extension portion on a first side of the patient,

placing the self-fixating tip of the second extension portion on a second side of the patient,

placing the tissue support portion at a location to support tissue of the urethra, and

using the adjusting tool to adjust the placement of the support portion piece relative to one of the two extension portions.

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